GUADALUPE RIVER PROJECT
DOWNTOWN SAN JOSE, CALIFORNIA

Multiple Lines of Evidence Report: Mitigation Monitoring Anadromous Fish Occurrence, Adult Migration and Spawning

Prepared for:

San Francisco Bay Regional Water Quality Control Board and the
Guadalupe River Project Adaptive Management Team

Prepared by:

Santa Clara Valley Water District

Environmental Mitigation and Monitoring Unit

August 2, 2018

COVER PHOTOS:

Left: Redd on Guadalupe Creek, December 2016.

Top Right: Adipose fin-clipped (hatchery) Chinook salmon on the Guadalupe River captured during up-migrant trapping in 2003.

Lower Middle: Chinook salmon image recorded with the Vaki Riverwatcher at Alamitos Drop Structure, 2004.

Lower Right: Adipose fin-clipped (hatchery) Chinook salmon head collection on Alamitos Creek, December 2016. Natal origin confirmed as Feather River Hatchery released at Johnson Pier in Half Moon Bay, CA.

All images of Chinook salmon and spawning occurrences were taken upstream of the Guadalupe River Project.

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EXECUTIVE SUMMARY

The downtown Guadalupe River Project (Project) was designed to provide flood protection to a portion of downtown San Jose, California, and surrounding areas while avoiding, minimizing, and mitigating adverse Project effects on fish and wildlife habitat for threatened and endangered species. In association with this Project, biological resources monitoring is required to ensure reestablishment of ecological function and habitat value of areas impacted by the Project. This multiple lines of evidence report was prepared at the request of the San Francisco Bay Regional Water Quality Control Board (RWQCB) and senior managers of the Project's Adaptive Management Team (AMT) to document fulfillment of the mitigation monitoring requirement for Central Valley fall-run Chinook salmon (*Oncorhynchus tshawytscha*) adult migration and spawning.

The United States Army Corps of Engineers (Corps) and Santa Clara Valley Water District (SCVWD) have monitored the anadromous fish occurrence; adult migration and spawning indicator since 2001, as specified by the Project's RWQCB Order No. 01-036 (RWQCB Order), Biological Opinion (BO) and Supplemental BO from the National Marine Fisheries Service (NMFS 2003), all of which incorporate the Project's Mitigation and Monitoring Plan (MMP) (Corps 2001) by reference. Determining whether monitoring may be considered complete depends on meeting the MMP measurable objectives (MO) for the indicator. The MO for the anadromous fish adult migration and spawning indicator is: *The Guadalupe River must continue to support migration and spawning of adult steelhead and Chinook salmon at a level that is consistent with pre-Project conditions and environmental conditions not affected by the Guadalupe River Project.* (The MO was eventually revised to exclude steelhead by AMT consensus following a science panel review process.)

The AMT reviews monitoring results to determine whether MOs established by the MMP have been achieved. Monitoring continues for each indicator until the MO is met. In the case of Chinook salmon adult migration and spawning, the AMT is not in consensus whether the MO has been met. This report provides multiple lines of evidence demonstrating the Chinook salmon adult migration and spawning MO has been met and, as such, the monitoring requirement should be considered complete for this indicator:

1. **Fish passage improvements have expanded the distribution of salmonids.**

   The SCVWD and partners have made 14 major fish passage improvements in the Guadalupe River watershed. In addition, Guadalupe Creek and the Guadalupe River Reach A, near Mineta San Jose International Airport, were restored as part of the Project. These efforts have expanded habitat and helped fish migrate further upstream to spawning areas. In addition, MMP protocol specifies prompt removal of barriers to fish passage occurring in the Project's hardscape reaches during the fall, winter, and spring months. Fish passage surveys have been conducted during base flows and after major flow events every year. Monitoring of depth, velocity, and vertical barriers will continue for the lifespan of the Project (100 years) in accordance with the MMP to ensure anadromous fish passage is maintained.

2. **Spawning surveys demonstrate that the Guadalupe River supports migration and spawning of adult Chinook salmon at levels consistent with pre-Project conditions, thus satisfying the MO.**

   Fourteen years of Project-specific monitoring data compared with standardized data from previous efforts demonstrate similar pre- and post-Project Chinook salmon spawning and migration levels. The number of redds (areas in the stream where the fish lay their eggs) averaged 10.0 pre-Project and 12.2 post-Project. Similarly, the average number of live fish observed pre-Project was 5.6 compared to 7.8 post-Project. The number of carcasses (Chinook salmon die after spawning) averaged 2.4 pre-Project compared to 4.2 post-Project.

3. **Additional fisheries monitoring demonstrates Chinook salmon occurrence post-Project is consistent with pre-Project levels and habitat expansion has occurred.**

   In addition to the required monitoring for the Project, SCVWD also conducted up-migrant trapping and passive surveys using a Vaki Riverwatcher (VR). The VR recorded occurrences of Chinook salmon upstream of the Project in all years of operation (which were all post-Project). Up-migrant trapping data showed similar pre- and post-Project returning Chinook salmon numbers in the Guadalupe River.

4. **Chinook salmon trends in the Guadalupe River watershed follow Central Valley Fall-run escapement.**

   Yearly fluctuations in the number of redds in the Guadalupe River watershed follow similar trends to Central Valley Fall-run Chinook salmon stocks with a peak in 2003 and substantial decline in Water Years (WYs) 2009 and 2010. The overall linear trend of both datasets is declining and the post-Project monitoring period coincided with declines in Chinook salmon abundance statewide. The statewide decrease in WYs 2008 to 2010 resulted in the California Fish and Game Commission instituting an emergency closure of commercial and recreational salmon fishing for the entire state. Fluctuations in Chinook salmon occurrence in the Guadalupe River watershed reflect environmental conditions not affected by the Project.

This multiple lines of evidence report is part of a request to end monitoring of the anadromous fish occurrence, adult migration and spawning indicator, which is one of 25 monitoring indicators for the Project. Monitoring results and other analyses presented in this report adequately verify that monitoring of the anadromous fish occurrence, adult migration and spawning indicator can be considered completed for the Project in compliance with the RWQCB Order, BOs, and MMP.

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INTRODUCTION

1. Report Objectives

This multiple lines of evidence report was prepared at the request of senior managers of the San Francisco Bay Regional Water Quality Control Board (RWQCB) and Guadalupe River Project Adaptive Management Team (AMT) to justify completing mitigation monitoring of Chinook salmon migration and spawning for the Project. The United States Army Corps of Engineers (Corps), Santa Clara Valley Water District (SCVWD), and consultants have monitored the anadromous fish occurrence, adult migration and spawning indicator for the Downtown Guadalupe River Project (Project) for 17 years to-date (2001-2017). The Project's RWQCB Order No. 01-036 (RWQCB Order) and Biological Opinion (BO) and Supplemental BO from the National Marine Fisheries Service (NMFS 2003) incorporate by reference the Mitigation and Monitoring Plan (MMP) (Corps and SCVWD 2001), which requires the indicator be monitored for ten years. Determining whether monitoring may be considered complete depends on meeting the MMP measurable objective (MO). The multiple lines of evidence presented in this report to demonstrate that the MO has been met include:

1. Fish passage improvements have resulted in range expansion that doubled the available habitat for salmonids. In addition, fish passage barrier remediation will continue in the hardscaped reaches of the Project for the life of the Project;

2. Spawning survey data demonstrates similar pre- and post-Project spawning levels, thereby meeting the MO;

3. Additional fisheries monitoring indicates Chinook salmon successfully passed upstream of the Project in all years this monitoring occurred and corroborates that post-Project Chinook salmon levels are consistent with pre-Project levels; and

4. Chinook salmon occurrence in the Guadalupe River watershed follows similar trends as Central Valley Fall-run Chinook salmon escapement, indicating that other environmental variables outside of the Project have an influence on returning fish.

The discussion of each line of evidence factors in the quality and quantity of data and significance of each line of evidence.

2. Project and Monitoring Background

The Downtown Guadalupe River Project (Project) is situated between the Upper Guadalupe River Project (UGRP) and the Lower Guadalupe River Flood Protection Project (LGRP). Los Gatos Creek, a major tributary, flows into the Guadalupe River within the Project area (Figure 1). The Project was designed to provide flood protection along the Guadalupe River between Interstate Highways 280 (I-280) and 880 (I-880) in downtown San Jose, California (Figure 2).

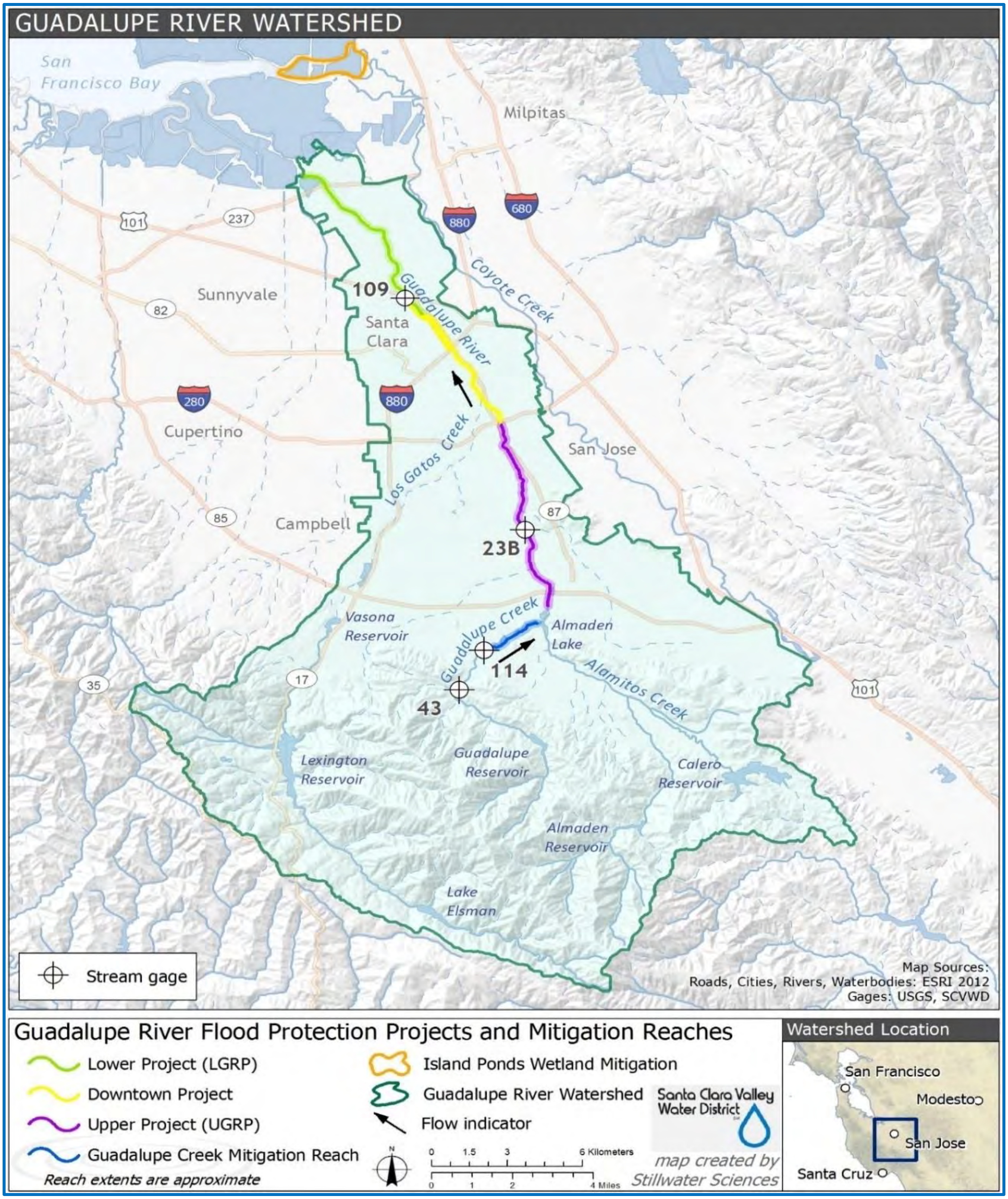

Figure 1: Guadalupe River watershed map including Guadalupe River flood protection projects and mitigation reaches.

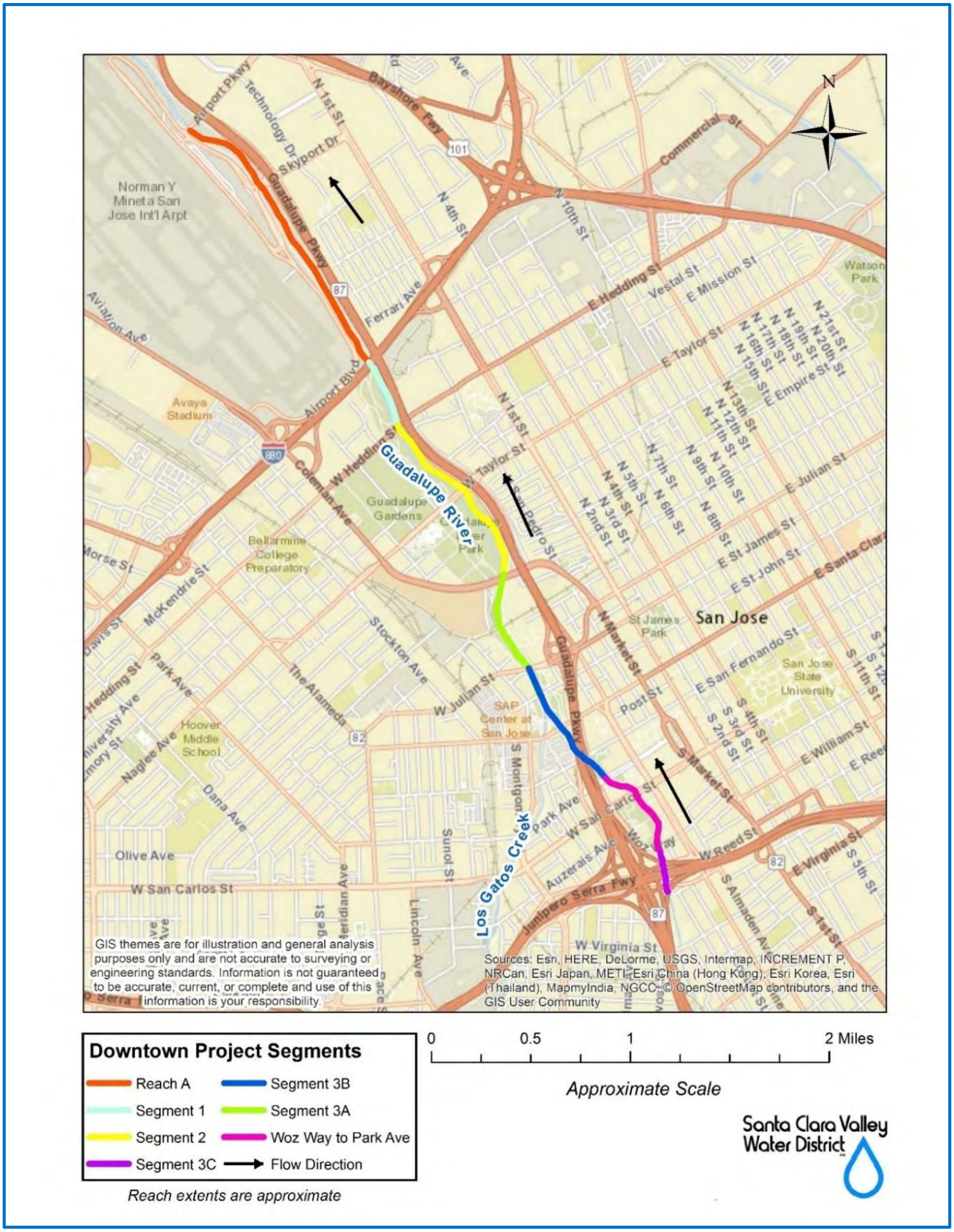

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Figure 2: Location and segments of the Downtown Guadalupe River Project.

Figure 2 shows the Project reaches and segments, not including mitigation restoring Guadalupe Creek from Almaden Expressway to Masson Dam. Reach A was also restored as mitigation for the Project. The Project included channel enlargement, armoring, flood bypass culverts, freeboard berms, bridge structure improvements, and floodwalls to convey the flood peak discharge for the design event. The Project also provided recreation, preserved existing riparian and shaded riverine aquatic (SRA) cover vegetation, and mitigated for vegetation removal. The Project uses adaptive management and the AMT as a decision-making process to optimize the long-term implementation of flood protection measures and mitigation on the Guadalupe River, with an objective of reestablishing the ecological functions and habitat values affected by the Project. Through the adaptive management process and permit requirements adopted by the RWQCB Order, which are detailed in the Project's MMP, 26 indicators with MOs assessing riparian vegetation, SRA cover, water temperature, anadromous fish spawning habitat, anadromous fish passage and rearing habitat, and anadromous fish occurrence are periodically monitored and evaluated. Each indicator has a specific monitoring schedule, duration, and year(s) when the MO is required to be met. Results are reported annually to the AMT in a mitigation monitoring report (MMR) and yearly AMT meetings are held to discuss results, condition of the river and Project mitigation sites, and determine if monitoring changes or remedial actions are needed.

The mitigation monitoring indicator addressed in this document is anadromous fish occurrence, adult migration and spawning, for Fall-run Chinook salmon (*Oncorhynchus tshawytscha*). Starting in Water Year (WY) 2001, the Corps and SCVWD monitored Fall-run Chinook salmon and steelhead/rainbow trout (*Oncorhynchus mykiss*) spawning as specified in the MMP. Following a Science Panel recommendation and subsequent AMT consensus (recommendation 118) in 2010, steelhead spawning monitoring was discontinued from February through April, since surveys were generally ineffective, and juvenile rearing monitoring provided more useful results for assessment steelhead occurrence (WY 2010 MMR, SCVWD and H.T. Harvey and Associates 2011). The recommendation called for Chinook salmon spawning monitoring from the first freshet to December 31, or mid-January (if there is a late wet season). The Corps, SCVWD, and consultants conducted 14 years (WY 2001–2014) of spawning surveys in the Guadalupe River watershed following the MMP and Science Panel recommended methods. These surveys have clear methods specified by the MMP and Implementation Plan (IP) (Jones & Stokes 2004), including consistent survey reaches, and a standardized level of effort. Due to extreme drought conditions in WY 2015 and 2016, Chinook salmon migration and spawning was not directly monitored, but observations of the river and creeks showed migration was not possible due to low flows and river dryback. Spawning surveys occurred in WY 2017 and 2018, but are not included in this report, as the data collection occurred after the dispute resolution process started (Those results are available in the WY 2017 MMR (SCVWD, Corps, and Stillwater Sciences 2018) and will be available in the WY 2018 MMR available in 2019).

The standardized data collection method utilized for the Project's MMP provides one year of pre-Project (WY 2001) and 13 years of post-Project data (WYs 2002-2014). This level of effort exceeded the 10-year monitoring commitment in the Project MMP and IP.

The MO for the anadromous fish occurrence, adult migration and spawning indicator is as follows: *The Guadalupe River must continue to support migration and spawning of adult steelhead and Chinook salmon at a level that is consistent with pre-Project conditions and environmental conditions not affected by the Guadalupe River Project.* (The MO was eventually revised by the AMT to exclude steelhead.) The MO has consistently been reported as being met in annual MMRs from WY 2001 through 2014. However, the Water Power Law Group (WPLG) representing the Guadalupe-Coyote Resource Conservation District (GCRCD), Pacific Coast Federation of Fisherman's Associations, and Trout Unlimited on the AMT do not agree that the MO is met. A Notice of Dispute was submitted in 2009, resulting in the formation of a Science Panel of AMT-approved independent consultants and SCVWD scientists, and subsequent AMT recommendations. AMT recommendation 118 revised the monitoring indicator methods, as described previously, but the MO for the indicator was not modified, despite Science Panel guidance to not use it to determine compliance (see Appendix P of the WY 2010 MMR, SCVWD and H.T. Harvey and Associates 2011). The dispute over this monitoring indicator reemerged in 2016, when the WPLG did not vote in consensus of determining the MO met and monitoring completed (see Appendix R of the WY 2015 MMR, SCVWD, Corps, and Stillwater Sciences 2016). As part of the dispute resolution process, this report provides multiple lines of evidence demonstrating the anadromous Chinook salmon fish occurrence, adult migration and spawning MO is met, given historical data and monitoring results, and that therefore, monitoring of this indicator can be considered completed for the Project.

3. Chinook Salmon (*Oncorhynchus tshawytscha*) Background

Monitoring and management decisions in the Guadalupe River watershed are frequently based on the habitat requirements and life history stages of two anadromous fish species: steelhead and Chinook salmon. A more complete understanding of the history of Chinook salmon in the watershed is necessary for such decisions to strike an appropriate balance when the requirements of steelhead and Chinook salmon differ or are in conflict. For this reason, a review of historical fish occurrence, habitat conditions, and hydrology was conducted for the watershed (see Appendix A). Although a definitive answer on the nativity of Chinook salmon in the Guadalupe River watershed cannot be made, there is no substantial evidence of historical presence (Chinook salmon have only been observed in Santa Clara County in the last 40 years), historical flow conditions were not supportive of a persistent population, and the current population is of hatchery origin (Appendix A). Together, this body of evidence indicates that Chinook salmon are not endemic to the watershed. As such, where and when the requirements of steelhead and Chinook salmon differ or are in conflict, such as migration and flow timing, monitoring and management decisions in the Guadalupe River watershed should prioritize steelhead, which is indisputably native to the watershed and the populations of which are much more at risk.

MULTIPLE LINES OF EVIDENCE FOR COMPLETING CHINOOK SALMON MONITORING

1. Fish Passage Improvements in the Guadalupe River Watershed

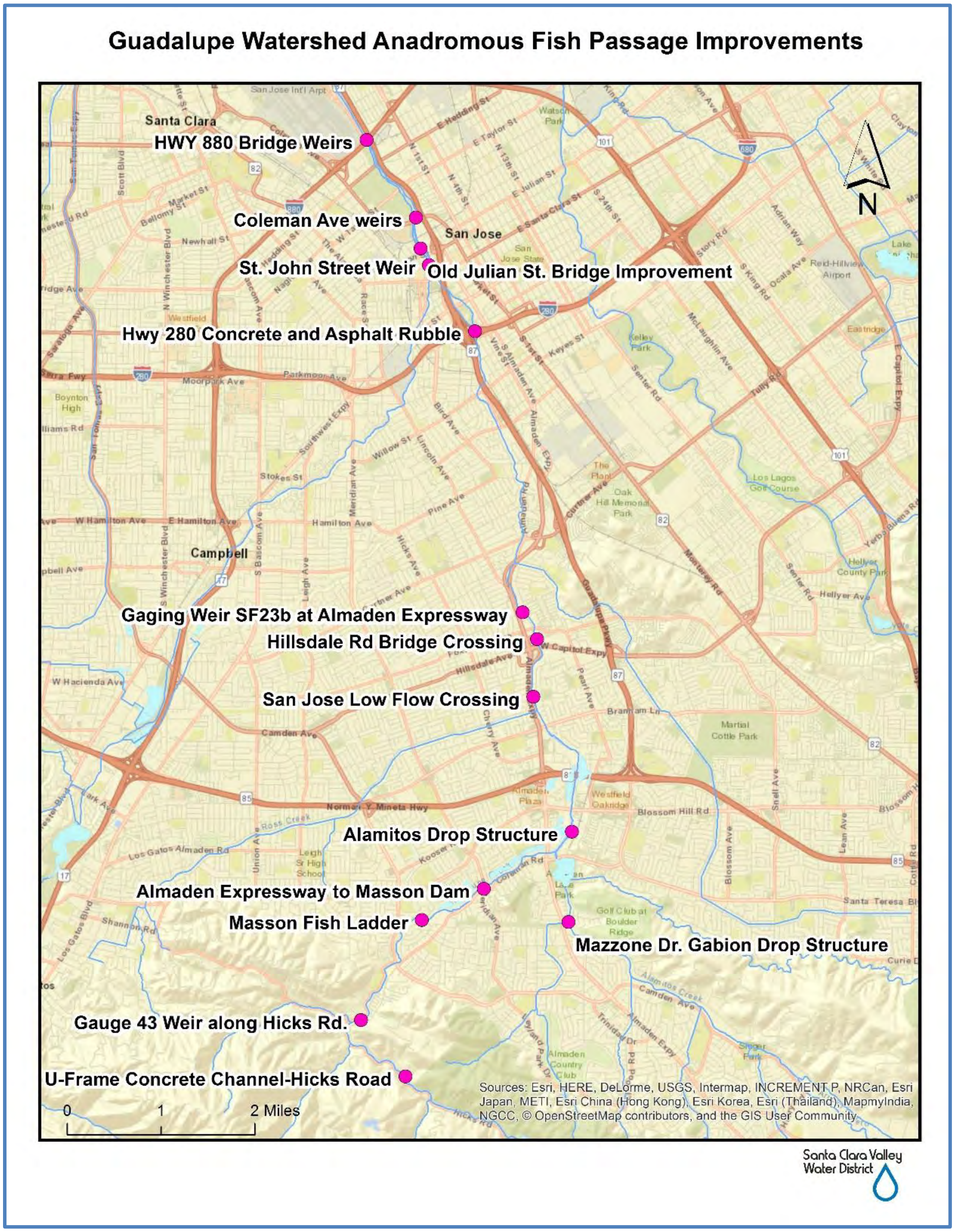
Structural passage barrier improvements

As part of the various Guadalupe River flood control projects and other SCVWD operations, 14 major passage improvements have occurred in the Guadalupe River watershed since 1994 (Table 1). These improvements include weir removal, installation or retrofit to control velocity, habitat improvement, and construction of fishways to improve passage over major barriers. Some of the passage improvements occurred as a result of the Project and were identified/remediated through the AMT process. The barriers remediated included temporal and partial, as well as complete passage barriers. The barrier remediation efforts not only opened access to previously blocked habitat, but also reduced the effort and duration of time required for fish to reach upstream spawning areas.

Table 1: Passage impediments, from downstream to upstream, remediated by the Project and other SCVWD activities within the Guadalupe River watershed.

Stream Name	Site Name	Improvement Type	Year
Guadalupe River	Hwy 880 Bridge Weirs	Weir Retrofit	1994
Guadalupe River	Downstream of Coleman Ave	Weir Installation	2004
Guadalupe River	Old Julian St. Bridge	Weir Installation	2003
Guadalupe River	St. John Street Weir	Weir Retrofit	2004
Guadalupe River	Hwy 280 Concrete and Asphalt Rubble	Channel Improvement	2002
Guadalupe River	Gauging Weir SF23b at Almaden Expressway	Weir Retrofit	1994
Guadalupe River	Hillsdale Road Bridge Crossing	Channel Improvement Steppools	2000
Guadalupe River	San Jose low flow crossing	Channel Improvement Steppools	1998
Guadalupe River	Alamitos Drop Structure	Fish ladder	1999
Guadalupe Creek	Almaden Expressway to Masson Dam	Spreader Dam removal/Channel Improvement	2002
Guadalupe Creek	Masson Dam	Fish Ladder	2000
Guadalupe Creek	Gauge 43 Weir along Hicks Road	Weir Retrofit	2004
Guadalupe Creek	U-Frame Concrete Channel-Hicks Rd.	Fish Ladder	2008
Alamitos Creek	Mazzone Drive gabion drop structure	Channel Improvement	1999

Figure 3 shows the spatial distribution of these fish passage improvements. Most passage improvements occurred on the mainstem of the Guadalupe River. These remediation activities helped support range expansion by providing access to areas previously inaccessible either temporally or permanently. The fish passage project that opened the greatest amount of available habitat was the installation of the Alamitos Fishway (a fish ladder in the Alamitos Drop Structure). This successfully reopened access to upstream tributaries and more than doubled the accessible habitat in the watershed. (The success of the fishway is discussed in the *Additional Chinook Salmon Monitoring* section of this report.) Even if passage impediments did not entirely block fish passage, impediments slowed movement, and concentrated fish within certain portions of the watershed. These concentrations restricted spawning to certain areas and increased the detectability of fish in the system by both the public and biological survey efforts. Therefore, it is highly likely that anadromous fish spawning post-Project is under-estimated compared to pre-Project, since it is not possible to monitor, or see all parts of the channel in the Guadalupe River and its tributaries that are now accessible to fish during surveys. The fish have much more spawning habitat available post-Project, which is beneficial, but they are more difficult to detect and count migrating and spawning numbers.


Guadalupe Watershed Anadromous Fish Passage Improvements
HWY 880 Bridge Weirs
Coleman Ave weirs
St. John Street Weir
Old Julian St. Bridge Improvement
Hwy 280 Concrete and Asphalt Rubble
Gaging Weir SF23b at Almaden Expressway
Hillsdale Rd Bridge Crossing
San Jose Low Flow Crossing
Alamitos Drop Structure
Almaden Expressway to Masson Dam
Masson Fish Ladder
Mazzone Dr. Gabion Drop Structure
Gauge 43 Weir along Hicks Rd.
U-Frame Concrete Channel-Hicks Road
Santa Clara
San Jose
Campbell
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2 Miles
Santa Clara Valley Water District

Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

Figure 3: Fish passage improvements in the Guadalupe River watershed.

Sediment-related passage impediment remediation

High flow events deposit gravel, fine sediment, and other debris in portions of the Project's hardscaped reaches (i.e., parts of Segment 3). This was a known design condition associated with the Project, and was part of the impetus for the MO. These reaches are comprised of a riverbed armored with concrete cellular mattress (CCM), concrete, floodwalls or gabions on the banks, and a constructed low flow channel within the armored riverbed. The low flow channel was constructed to assure fish passage and facilitate fish spawning.

As accumulated material fills the constructed low flow channel, the potential for fish passage can be affected during base flows. (Sediment-related passage impediments in the hardscaped reaches only delay migration if flow is concentrated in the low flow channel; they do not block passage for anadromous fish during all flow conditions.) SCVWD works to remediate this issue through a regimented monitoring and sediment removal schedule defined in the MMP and Fish Barrier Removal Protocol (Appendix C). This protocol, which was developed by the Project's AMT and has been utilized since 2003, sets specific procedures for the prompt removal of fish passage impediments within the hardscaped reaches of Project. The protocol does not apply to reaches with natural channel bottom. If fish barriers develop within the natural reaches, additional coordination and approval is required from the relevant resource agencies. Barriers within natural portions of the Guadalupe River are corrected under SCVWD's Stream Maintenance Program (SMP) or as separate projects.

The MMP and Fish Barrier Removal Protocol are designed to promptly remove barriers to fish passage during the fall, winter, and spring months with minimal disturbance to the river and aquatic life. Fish passage surveys occur every two weeks at base flows and after any flow event that exceeds 500 cubic feet per second (cfs) at the USGS Highway 101 stream flow gauge. A qualified fisheries biologist must determine (based on weather forecast, flow, likelihood that material will be naturally removed, timing in the season, etc.) if and when barrier remediation is required under the protocol. The Fish Barrier Removal Protocol calls for barriers to be removed within 48 hours after the barrier is identified, or when flows allow for safe access for crews to perform the work, and if no storm is forecasted to raise the river levels. Sediment removal is conducted to restore fish passage to at least the MMP criteria and to the design conditions of the constructed low flow channel, if possible.

Sediment deposition sufficient to require removal for fish passage occurs almost every year and most often occurs at Segments 3A (Coleman Avenue), 3B (under San Fernando Street), and Segment 3C (under Highway 280). According to the Project's MMRs at least 37 fish passage impediments associated with sediment deposition within the low flow channel were remediated using the Fish Barrier Removal Protocol. (The WY 2005 and 2006 MMRs did not provide specific dates and timing of passage impediments.) The highest number of passage impediments occurred in WY 2010 when eight removal efforts were required, but during the eight other years with records only one removal effort was necessary each year. Of these instances of sediment deposition, only ten occurred during the peak Chinook salmon migration period (October to December). The constructed low flow channel is designed to provide sufficient depth for passage at flows as low as 4 cfs. Flows of this level were observed in all years, except during the extreme drought conditions in WY 2015 and 2016 when channel drybacks occurred. As such, flows should have facilitated passage through the low channel in

Segment 3 every day during the Chinook salmon migration period from WY 2004 through 2014. The only times passage was not available were the ten instances of sediment accumulation in the low flow channel during the peak Chinook salmon migration period. The influence of these instances on the number of passage days is summarized in Table 2. Based on the number of days between impediment identification and removal, sediment accumulations reduced the number of passage days by an average of 3% (Table 2). Due to the diligence of survey and passage remediation, sediment accumulations result in a minor delay to migration of Chinook salmon, and in some years no delay at all. Passage remediation activities and associated depth, velocity, and vertical barrier monitoring will continue for the lifespan of the Project (100 years) in accordance with the MMP.

Table 2: Sediment passage impediment monitoring and remediation in the Project hardscaped reaches during peak Chinook salmon migration period and the percentage of passage days with impediments.

Water Year	Segment 3A		Segment 3B		Segment 3C		# Days Impediment Present	Total Passage Days[a]	% of Passage Days with Impediments
	Identified	Removed	Identified	Removed	Identified	Removed			
2004	No Dates Recorded								
2005	None identified		Nov 1	Nov 4	Nov 1	Nov 4	15[b]	92	16%[b]
	None identified		Jan 5	Jan 18					
2005	No Dates Recorded								
2006	No Dates Recorded								
2007	None identified		Dec 11	Dec 14	None identified		3	92	3%
2008	Jan 7	Jan 10	Jan 7	Jan 10	Jan 7	Jan 10	3	92	3%
2009	None identified		Nov. 5	Unknown	Nov. 5	Unknown	Unknown	92	Unknown
2010	Oct 19	Oct 20	Oct 19	Oct 21	Oct 19	Oct 21	2	92	2%
2011	None identified		Jan 3	Jan 5	None identified		2	92	2%
2012	None identified		None identified		None identified		0	92	0%
2013	Jan 2	Jan 4	Jan 2	Jan 4	None identified		2	92	2%
2014	None identified		None identified		None identified		0	92	0%
2015	Dec 18	Dec 23	Dec 18	Dec 30	None identified		3[c]	0[d]	0%
2016	Jan 8	Jan 12	None identified		None identified		4[e]	0[d]	0%

[a] Based on October to January peak Chinook salmon migration period. Flows were sufficient for fish passage during this period in all years except 2015 and 2016.

[b] Passage was not blocked this entire time: flow exceeded 100 cfs for 12 of the days that the impediment was in place and peaked at over 1,000 cfs during this time.

[c] Flow less than 4 cfs through Segment 3 resumed on December 22, 2014 after a short storm event. Extreme drought conditions resulted in no passage through the reach.

[d] Sustained flow through the Project reach was not maintained long enough during these extreme drought years to allow fish to migrate upstream.

[e] Impediment was not a result of sediment accumulation, but a mattress and trash accumulated in the channel. It was not a complete blockage.

Conclusions

According to the BO from NMFS, fish passage is assured through implementation of the MMP that utilizes an adaptive management strategy (NMFS 2003). The Corps and SCVWD are committed to ensuring the Project does not impede fish passage. The fish passage improvements made in the watershed have expanded the range of anadromous fish since pre-Project conditions to include areas that are more suitable for multiple life-stages of anadromous fish. The annual efforts to remediate passage impediments through the hardscape reaches have been successful in limiting the areas and number of days when migration may be impaired. The adult migration and spawning monitoring indicator was designed to provide information on the adequacy of fish passage and aid in the identification of potential passage impediments (WY 2010 MMR, SCVWD and H.T. Harvey and Associates 2011). The fish passage improvements and sediment remediation described in this section are an essential line of evidence that conditions within the Guadalupe River watershed are improved for migration and spawning of salmonids compared with pre-Project conditions.

2. Pre- and Post-Project Chinook Spawning Data

Guadalupe River Project monitoring

The Corps and SCVWD started monitoring the adult migration and spawning indicator in WY 2001.The MMP states that, “(v)isual observation of migrating or spawning adult steelhead and chinook salmon, carcasses of chinook salmon (because chinook salmon die after spawning), and redds will be recorded…Surveys will be conducted a minimum of 4 times each year prior to Project construction and for the first 10 years after Project construction. The AMT will determine the need for surveys after year 10. Specifically, steelhead surveys will occur in February and in March of each year, and Chinook salmon surveys will occur in late October and late November” (Corps and SCVWD 2001). For the purposes of migration and spawning monitoring, post-Project is considered to be when and after most of the CCM was constructed in WYs 2002 and 2003, and monitoring in WY 2001 is considered to be pre-Project. Project monitoring of the migration and spawning indicator therefore provides one year of pre-Project (WY 2001) and 13 years of post-Project data (WYs 2002-2014), which exceeds the 10-year monitoring requirement.

After the first year of data collection in WY 2001, SCVWD fisheries biologists saw a need to expand the survey effort to better understand the resources. The WY 2001 MMR provides recommendations for the additional monitoring and an increased level of effort. In WY 2002 additional monitoring reaches were added, and the increased effort was formally added to the NMFS 2003 supplemental BO (NMFS 2003). In WY 2003 Chinook salmon surveys were conducted within 7 reaches: 4 on the mainstem of the Guadalupe River and 1 each on Los Gatos, Alamitos, and Guadalupe Creeks. Also beginning in WY 2003, SCVWD conducted spawning surveys at all 7 reaches for Chinook salmon on a bi-weekly basis (when flows allowed safe access to the channel and conditions allowed observations), rather than 4 times per year, starting in October and continuing to January. Until WY 2010, following a recommendation by the Science Panel and consensus by the AMT that deemed them ineffective, surveys for steelhead spawning surveys were conducted at the same bi-weekly interval between January and mid-April. Most of the monitoring, therefore, has included more portions of the watershed and was conducted more frequently than was originally required.

Other monitoring

Since the Project-required migration and spawning monitoring only included one year of pre-Project conditions, additional data from prior surveys conducted by SCVWD and private consultants representing WYs 1995-2000 were compiled and analyzed to provide a more complete picture of pre-Project conditions and to answer the MO. Unpublished spawning survey data collected by SCVWD fisheries biologists from WYs 1996-2000 was cited in the Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Upper Guadalupe River Flood Control Project (UGRP) (SCVWD and Corps 1999), but the methods utilized were not formally documented. The data from these surveys, as recorded in the Excel spreadsheets of a retired SCVWD fisheries biologist, were reviewed for preparation of this report, and included survey dates, reaches surveyed, and the number of redds, carcasses, and live fish observed. These surveys were conducted to help develop an understanding of Chinook salmon in Santa Clara County since the species was a new arrival, and therefore involved no specific hypotheses or study questions. The level of survey effort and timing varied year to year. The recorded data from these surveys are provided in Appendix B.

Additional spawning survey data collected in WY 1995 was reported in the *Salmonid Study of Guadalupe River, Coyote Creek, and Select Tributaries 1994-95 Report of Field Work* by the Habitat Restoration Group (HRG 1995) (provided in Appendix B). The timing and location of this survey overlapped with some of the WYs 1996-2000 and 2001-2014 datasets.

Chinook salmon spawning data from 1986-1987 by the Habitat Restoration Group (HRG 1995) were discussed in the UGRP EIR/EIS. During this survey effort, 28-31 redds were found between I-280 and the confluence with Canoas Creek. It appears this data collection effort targeted predetermined potential spawning habitats and did not look at all the available habitat. This survey effort did not overlap any of the WY 2001-2014 monitoring reaches and thus was not used for the pre- and post-Project comparison.

A draft untitled scanned report by Dr. Jerry Smith (Professor Emeritus in Biological Sciences, San Jose State University) provided by California Department of Fish and Wildlife (CDFW) has more information on the HRG 1986-1987 survey effort and includes additional spawning surveys conducted by CDFW. These surveys were associated with the first occurrences of Chinook salmon in the watershed that were related to the IBM Fairchild groundwater clean-up effort (J. Smith 2017). This clean-up effort was releasing groundwater continuously into Canoas Creek, a tributary to the Guadalupe River, and the survey extent appears to have been from Highway 237 to the Canoas Creek confluence. The draft report is incomplete and does not provide details on the level of survey effort, survey recurrence intervals, dates of surveys, or methods. The number of “spawning depressions” (the term redd was not used) reported were, evidently a combination of both steelhead and Chinook salmon spawning depressions. The draft report indicates that 262 spawning depressions were recorded during the CDFW effort, far more than ever recorded since, and Chinook salmon were even observed in the portion of Canoas Creek that was concrete-lined. However, handwritten notes on the report indicate subtractions from the total number of spawning depressions reported. These spawning depressions do not equate to specific redds but include test redds and other sediment disturbance commonly created by Chinook salmon and steelhead (J. Smith 2017). There are other likely reasons for the anomalously high number of spawning depressions recorded by CDFW in 1986-1987. During that season, there were no (or very few) winter storms to scour redds, and the discharge was clear groundwater creating excellent visibility, and likely low temperatures that attracted Chinook salmon. Typically, winter storms scour the channel in more urbanized zones owing to rapid impervious surface runoff. This scour masks the redds, rinses out fish carcasses, and creates murky conditions reducing both redd and fish detection. Conditions observed in 1986-1987 have not been present since the IBM groundwater pumping ceased. The unknown percentage of steelhead versus Chinook salmon spawning depressions, number of actual redds versus other depressions, and lack of description of methods makes the data difficult to compare with the survey efforts in WY 1995-2014. The scanned draft report is included in Appendix B. A final report has never been located or presented to SCVWD.

Data evaluation and standardization

All Chinook salmon spawning occurrence data (i.e., number of redds, carcasses, and live fish) from WYs 1995-2014, collected between October and December in Guadalupe River watershed reaches, is presented in Table 3 (individual locations of spawning occurrences are not provided in any dataset). The standardized, comparable data is presented in Table 4. Evaluating the data in these tables, for the proposes of comparing pre- and post-Project Chinook salmon spawning, requires an understanding of the primary differences and limitations in the data:

- As alluded to previously, levels of survey effort were not consistent from year to year for the 1995-2000 pre-Project dataset.
- In WYs 1995-1998, a greater number of stream miles were surveyed than in WYs 1999-2014, resulting in an approximately 25% greater survey area. This greater survey area resulted in a higher probability of detecting Chinook salmon.
- Pre-Project surveys (WYs 1995-1999) were performed when fish passage barriers confined migration, congregating salmon in certain locations, and thus making detection of both fish and redds easier. After fish barrier remediation and fishway installation occurred on Alamitos Creek, Guadalupe River, and Guadalupe Creek (see Table 1), salmon and steelhead could disperse and spawn in 16 additional miles of habitat. This made detection of fish and redds more difficult since fish were able to disperse more widely throughout the system. Thus, the number of spawning occurrences in WYs 2001-2014 is expected to be lower or distributed differently than pre-2001 when barriers were still present.

Due to these kinds of differences, standardization of the data was necessary to enable pre- and post-Project comparisons, which requires comparable survey timing and area (see Table 4). Data was trimmed to only include the months of October through December to capture the peak Chinook salmon migration and lower the potential for including steelhead spawning in the results. The 1995-2000 dataset did not specify species of fish when redds were detected and included redd occurrences from February to May, which based on life history timing, are likely not Chinook salmon. To reduce the risk of counting steelhead spawning occurrences as Chinook salmon, all data from surveys in February-May were omitted from the analysis. Although they were included in the comparison in Table 4, redds observed in January are likely those of steelhead and raise the pre-Project numbers compared to post-Project, since the post-Project dataset does not include surveys in January. Only one WY had surveys conducted before October, which were omitted from Tables 3 and 4.

To standardize the data for differences in survey area, areas of overlapping effort (stream segments surveyed) were combined to create comparable stream reaches surveyed in each year. The sampling reaches used in WY 2001-2014 were used as the reference for creating comparable reaches. If reaches surveyed in WY 1995-2000 overlapped with areas surveyed in WY 2001-2014, and did not include a substantially longer reach of stream, they were considered suitable for comparison. This standardization provided spatial comparability and enabled the pre-Project WYs 1995-1999 number of miles surveyed to be similar to the WYs 2001-2014 dataset.

It is important to note that spawning surveys conducted for the Project do not cover all potential habitats throughout the Guadalupe River watershed, but provide a sample of spawning occurrence in portions of the Guadalupe River, Los Gatos Creek, Alamitos Creek, and Guadalupe Creek. As such, “zeros” in Tables 3 and 4 do not necessarily indicate that no fish returned to the watershed in that year. Further, the comparable data extracted from WYs 1995-2014 shows trends in spawning occurrences but does not provide a population estimate. The data reflects Chinook salmon presence in the months of October through December to focus on peak migration period when the highest density of fish are present, as well as to account for uncertainties in the data in regard to species.

Table 3: Chinook salmon spawning data collected in the Guadalupe River watershed between October and December in WYs 1995 to 2014.

			Pre-Project																					Post Project																																																														
River/Creek	Survey Reach[1]	Distance	WY 1995[2]			WY 1996			WY 1997			WY 1998			WY 1999			WY 2000			WY 2001			WY 2002			WY 2003			WY 2004			WY 2005			WY 2006			WY 2007			WY 2008			WY 2009			WY 2010			WY 2011			WY 2012			WY 2013			WY 2014		
			R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C
Guadalupe River	Tasman Dr to Highway 101[3]	3.16	5	8	-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Montague Expwy to Trimble Rd[3]	1.10	-	-	-	0	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Trimble Rd to Hwy 101[3]	0.47	-	-	-	-	-	-	-	-	-	1	0	0	1	1	0	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Hwy 101 to Airport Prkwy[3]	0.72	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Montague Expwy to Airport Prkwy[3]	2.31	-	-	-	14	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Hwy 101 to Hwy 880[4]	1.94	-	-	-	-	-	-	2	6	0	0	0	0	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Hwy 880 to Coleman Ave[4]	1.00	-	-	-	-	-	-	-	-	-	3	6	0	2	2	0	-	-	-	0	0	0	1	0	1	5	4	3	2	1	0	2	1	1	0	4	0	1	1	2	1	0	0	0	0	0	0	0	0	1	0	0	0		0	2	0	0	4	3	0
Guadalupe River	Airport Prkwy to Coleman Ave[4]	2.24	2	3	-	21	11	3	14	0	0	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Airport Prkwy to Hwy 880[4]	1.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	3	5	2	9	10	3	3	0	1	3	0	1	1	2	2	2	1	1	0	0	0	0	0	0	3	2	0	1	0	2	1	0	2	0	0	0	2	4	1
Guadalupe River	Coleman Ave to St. John St[4]	0.53	-	-	-	11	3	5	-	-	-	-	-	-	-	-	-	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Coleman Ave to Hwy 280[4]	1.44	-	-	-	-	-	-	-	-	-	0	0	1	0	0	0	-	-	-	0	0	0	0	1	1	8	12	4	1	0	2	1	0	1	3	1	4	2	3	2	9	0	0	2	0	0	2	0	0	2	0	0	4	2	1	2	2	0	4	0	0
Guadalupe River	Coleman Ave to Alma Ave[3 & 4]	2.54	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	St John St. to Grant Ave[4]	0.91	-	-	-	2	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Grant Ave/Hwy 280 to Curtner Ave[5]	2.29	-	-	-	1	0	2	-	-	-	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Alma Ave to Willow Glen Way[5]	0.42	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Willow Glen Way to Canoas Creek Confluence[5]	1.12	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Canoas Creek Confluence to Hillsdale Rd[5]	0.81	4	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Hillsdale Rd to Capitol Expwy[5]	0.20	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Capitol Expwy to Branham Ln [5]	0.92	0	1	-	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Curtner Ave to Branham Ln[5]	2.18	-	-	-	7	20	27	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Branham Ln to Alamitos Drop[5]	1.30	2	0	-	2	1	1	-	-		0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guadalupe River	Branham Ln to Blossom Hill Rd[5]	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	0	0	0	0	0	0	0	3	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Guadalupe River Totals			**26**	**29**	**0**	**58**	**46**	**47**	**16**	**6**	**0**	**7**	**7**	**2**	**5**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**4**	**6**	**4**	**24**	**28**	**10**	**6**	**1**	**3**	**6**	**1**	**3**	**7**	**7**	**7**	**6**	**5**	**6**	**10**	**0**	**0**	**2**	**0**	**0**	**5**	**2**	**0**	**4**	**0**	**2**	**6**	**2**	**3**	**4**	**2**	**0**	**10**	**7**	**1**
Los Gatos Creek	W. San Carlos St to Meridian Ave[6]	1.58	-	-	-	-	-	-	5	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	W. San Carlos St to Lincoln Ave[6]	0.85	-	-	-	-	-	-	-	-	-	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	Lincoln Ave to Leigh Ave[6]	1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	15	6	1	6	1	5	2	3	1	2	0	0	1	0	3	2	1	3	0	0	2	0	0	4	0	1	1	0	1	5	1	0	1	0	0
Los Gatos Creek	Lincoln Ave to Meridian Ave[6]	0.74	-	-	-	0	0	1	-	-	-	0	0	0	2	2	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	Meridian Ave to Hamilton Ave[6]	1.51	-	-	-	2	0	1	-	-	-	0	0	0	3	1	0	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	Meridan Ave to Campbell Ave[6]	2.13	-	-	-	-	-	-	33	40	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	Hamilton Ave to Campbell Ave[6]	0.60	-	-	-	-	-	-	-	-	-	0	0	1	5	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek	Campbell Ave to Camden Drop[6]	1.16	-	-	-	-	-	-	1	1	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos Creek Totals			**-**	**-**	**-**	**2**	**0**	**2**	**39**	**46**	**12**	**0**	**0**	**2**	**10**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**15**	**6**	**1**	**6**	**1**	**5**	**2**	**3**	**1**	**2**	**0**	**0**	**1**	**0**	**3**	**2**	**1**	**3**	**0**	**0**	**2**	**0**	**0**	**4**	**0**	**1**	**1**	**0**	**1**	**5**	**1**	**0**	**1**	**0**	**0**
Alamitos Creek	Almaden Lake to Greystone Ln[7]	1.80	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	-	-	-	-	-	-	-	-	-	0	0	0	2	1	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	4	2	0	6	4	1	3	1	1	2	0	0
Guadalupe Creek	Almaden Expwy to Masson Dam[7]	1.70	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	0[8]	-	-	-	-	-	-	0	0	0	0	0	1	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0
Alamitos and Guadalupe Creek Total			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**7**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**6**	**2**	**1**	**7**	**4**	**1**	**3**	**1**	**1**	**2**	**0**	**0**
Total Miles Surveyed			13.43			13.78			11.23			11.76			9.99			1.98			3.64			5.34			9.64			9.64			9.64			9.64			9.64			9.64			9.64			9.64			9.64			9.64			9.64			9.64		

R-Redd **C**-Carcass **L**-Live Fish **-** No data available; [1]Survey reaches overlap between years and may extend outside of the Project area [2]Data collected by Habitat Restoration Group [3]Lower Guadalupe River Flood Project [4]Downtown Guadalupe Project [5]Upper Guadalupe Flood Control Project [6]Los Gatos Creek (confluence within Downtown Guadalupe Project) [7]Tributaries upstream of all flood control projects [8]Alamitos Drop Structure blocked access to upper tributaries so counts presumed to be zero

As indicated by Miles Surveyed it is evident that the survey effort was not consistent WY 1996-WY 2000. Consistent data collection occurred WY 2001-2014

Table 4: Standardized Chinook salmon spawning data collected in the Guadalupe River watershed between October and December in WYs 1995 to 2014.

River/Creek	Reach/Segment	Survey Reach	Pre-Project																				
			WY 1995			WY 1996			WY 1997			WY 1998			WY 1999			WY 2000			WY 2001		
			R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C
Guadalupe River	Reach A, Segments 1 and 2	Hwy 101 to Coleman Ave	2	3	0	21	11	3	16	6	0	6	7	1	4	2	0	-	-	-	0	0	0
Guadalupe River	Segment 3 and Reach 6	Coleman Ave to Alma Ave	0	1	0	13	6	10	-	-	-	0	0	1	0	0	0	2	0	0	0	0	0
Guadalupe River	Reach 12 (UGRP)	Branham Ave to Alamitos Drop Structure	2	0	0	2	1	1	-	-	-	0	0	0	-	-	-	-	-	-	-	-	-
Guadalupe River Totals			**4**	**4**	**0**	**36**	**18**	**14**	**16**	**6**	**0**	**6**	**7**	**2**	**4**	**2**	**0**	**2**	**0**	**0**	**0**	**0**	**0**
Guadalupe Creek/Alamitos Creek[1]	Upstream of the Project	Guadalupe/Alamitos Creek	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	-	-	-	-	-	-
Los Gatos Creek[2]	Confluence within Segment 3	Lincoln Ave to Leigh	-	-	-	0	0	1	-	-	-	0	0	0	2	2	0	-	-	-	-	-	-
Total Observed			**4**	**4**	**0**	**36**	**18**	**15**	**16**	**6**	**0**	**6**	**7**	**2**	**6**	**4**	**0**	**2**	**0**	**0**	**0**	**0**	**0**
Guadalupe River Miles Surveyed			**6.7**			**3.7**			**4.2**			**7.9**			**4.4**			**1**			**3.3**		
Tributaries Miles Surveyed			**0***			**0***			**0***			**0.7***			**0.7***			**0**			**0**		

River/Creek	Reach/Segment	Survey Reach	Post-Project																				
			WY 2002			WY 2003			WY 2004			WY 2005			WY 2006			WY 2007			WY 2008		
			R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C
Guadalupe River	Reach A, Segments 1 and 2	Hwy 101 to Coleman Ave	4	5	3	14	14	6	5	1	1	5	1	2	1	6	2	3	2	3	1	0	0
Guadalupe River	Segment 3 and Reach 6	Coleman Ave to Alma Ave	0	1	1	8	12	4	1	0	2	1	0	1	3	1	4	2	3	2	9	0	0
Guadalupe River	Reach 12 (UGRP)	Branham Ave to Alamitos Drop Structure	-	-	-	2	2	0	0	0	0	0	0	0	3	0	1	1	0	1	0	0	0
Guadalupe River Totals			**4**	**6**	**4**	**24**	**28**	**10**	**6**	**1**	**3**	**6**	**1**	**3**	**7**	**7**	**7**	**6**	**5**	**6**	**10**	**0**	**0**
Guadalupe Creek/Alamitos Creek[1]	Upstream of the Project	Guadalupe/Alamitos Creek	0	0	0	0	0	1	7	2	1	1	1	1	1	1	0	1	0	0	0	0	0
Los Gatos Creek[2]	Confluence within Segment 3	Lincoln Ave to Leigh	-	-	-	10	15	6	1	6	1	5	2	3	1	2	0	0	1	0	3	2	1
Total Observed			**4**	**6**	**4**	**34**	**43**	**17**	**14**	**9**	**5**	**12**	**4**	**7**	**9**	**10**	**7**	**7**	**6**	**6**	**13**	**2**	**1**
Guadalupe River Miles Surveyed			**3.3**			**4.6**			**4.6**			**4.6**			**4.6**			**4.6**			**4.6**		
Tributaries Miles Surveyed			**1.7**			**5**			**5**			**5**			**5**			**5**			**5**		

River/Creek	Reach/Segment	Survey Reach	Post-Project																	
			WY 2009			WY 2010			WY 2011			WY 2012			WY 2013			WY 2014		
			R	L	C	R	L	C	R	L	C	R	L	C	R	L	C	R	L	C
Guadalupe River	Reach A, Segments 1 and 2	Hwy 101 to Coleman Ave	0	0	0	3	2	0	2	0	2	1	0	2	2	0	0	6	7	1
Guadalupe River	Segment 3 and Reach 6	Coleman Ave to Alma Ave	2	0	0	2	0	0	2	0	0	4	2	1	2	2	0	4	0	0
Guadalupe River	Reach 12 (UGRP)	Branham Ave to Alamitos Drop Structure	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Guadalupe River Totals			**2**	**0**	**0**	**5**	**2**	**0**	**4**	**0**	**2**	**6**	**2**	**3**	**4**	**2**	**0**	**10**	**7**	**1**
Guadalupe Creek/Alamitos Creek[1]	Upstream of the Project	Guadalupe/Alamitos Creek	0	0	1	0	0	0	6	2	1	7	4	1	3	1	1	2	0	0
Los Gatos Creek[2]	Confluence within Segment 3	Lincoln Ave to Leigh	3	0	0	2	0	0	4	0	1	1	0	1	5	1	0	1	0	0
Total Observed			**5**	**0**	**1**	**7**	**2**	**0**	**14**	**2**	**4**	**14**	**6**	**5**	**12**	**4**	**1**	**13**	**7**	**1**
Guadalupe River Miles Surveyed			**4.6**			**4.6**			**4.6**			**4.6**			**4.6**			**4.6**		
Tributaries Miles Surveyed			**5**			**5**			**5**			**5**			**5**			**5**		

R-Redd **C**-Carcass **L**-Live Fish **-** No data available [1]Alamitos Drop Structure blocked access to upper tributaries so counts presumed to be zero. [2]Los Gatos Creek has limited pre-Project comparable data.

Survey effort was not consistent WY 1995-2000 and no consistent/standardized data collection occurred until WY 2001. No comparable data was collected in WY 2000.

WY 2000 surveys were not conducted in the same reaches as other surveys and included only three recorded sampling events during the Chinook salmon migration period. (It is not known why the limited sampling effort occurred in this year as no formal report was prepared). This data was not collected as part of a specific study and did not have any formal study questions that needed to be answered. Including the data from WY 2000, in pre-Project averages as done in Table 5, lowers the pre-Project averages for Chinook salmon spawning occurrences. The reduction is not considered substantive, as it does not change the results of the comparison with post-Project occurrences (see Table 5).

Comparisons of pre-and post-Project data for Los Gatos Creek proved to be difficult. Pre-Project data collected in WY 1996-2000 had inconsistent survey reaches. For example, sampling in WY 1997 (pre-Project) is not truly comparable to post-Project data because it extended 1.4 miles further upstream. This increased distance provides more opportunity to detect spawning occurrences. In addition, the post-Project (WY 2002-2014) survey reach was completely unrestricted, with no passage impediments. The reach sampled in WY 1997 terminated at an unpassable drop structure that would serve to concentrate fish and provide higher occurrence rates. This was seen with the occurrence of 33 redds, 40 live fish, and 9 carcasses. This area was never sampled post-Project. The only truly comparable pre-Project data for Los Gatos Creek was collected in WYs 1996, 1998 and 1999 and it is therefore included in Table 4.

Table 5: Average pre- and post-Project Chinook salmon spawning occurrences.

River/Creek	Pre-Project			Post-Project		
	Redd	**Live Adult**	**Carcass**	**Redd**	**Live Adult**	**Carcass**
Guadalupe River	9.7	5.3	2.3	7.2	4.7	3.0
Guadalupe, Alamitos, and Los Gatos creeks	0.3	0	0	5.0	3.0	1.5
Watershed Total	10.0	5.6	2.4	12.2	7.8	4.2

Conclusions

The pre- and post-Project averages of redds, live fish, and carcasses, based on the standardized data in Table 4, are summarized in Table 5.

Although spawning survey data are not population estimates, the results in Table 5 demonstrate consistent levels of Chinook salmon migration and spawning pre- and post-Project, in compliance with the MO. When comparable redd survey data from Table 4 is analyzed, no dramatic change pre- to post-Project occurred.

The data is indicative of range expansion that occurred with barrier remediation. The total number of redds and live fish occurrences decreased on the mainstem of the Guadalupe River, but increased in upstream tributaries (Table 5). This shows a trend that Chinook salmon occurrences remained consistent, but fish could disperse into other parts of the watershed. The number of carcasses and live fish on the mainstem of the Guadalupe River remained approximately the same. Improved understanding of the range expansion that occurred for Chinook salmon is the most promising result of this monitoring. Evidence that Chinook salmon dispersed through the watershed, no matter the numbers, demonstrates that the Project is not limiting passage, and SCVWD habitat improvements have been successful in allowing range expansion. In fact, it is somewhat surprising that post-Project numbers so closely match pre-Project given that Chinook salmon could access an additional 16 miles of habitat after barrier remediation and, as such, surveys covered a much smaller proportion of accessible habitat.

Although the pre- and post-Project datasets are variable in terms of survey area, timing, and frequency, they represent the best information available, are a resource that not many watersheds are fortunate enough to possess, and provide sufficient information to evaluate the MO. The evidence of range expansion and comparable numbers of spawning occurrences in Table 5 provide confidence that migration and spawning of adult steelhead and Chinook salmon are at a level that is consistent with pre-Project conditions or potentially better.

3. Additional Chinook Salmon Monitoring

Up-migrant trapping

In addition to the Project and pre-Project datasets described previously, SCVWD has data on adult salmon occurrence from up-migrant trapping efforts (see Table 6). A funnel weir trap was used across the entire width of the channel to capture all up-migrating salmonids. Up-migrant trapping spanned WYs 1998-2001, 2002, 2004, and 2006. This dataset thus provides pre-Project as well as post-Project data, with WY 2004 (post-Project) having the highest number of adult Chinook captured (n=104). In some years, this data collection effort accounts for fish arriving before the spawning surveys commenced, including adult Chinook salmon returning post-Project in mid-August 2003 (WY 2004 escapement). The time period of trapping and number of trapping days differed each year due to flows and the various objectives of the annual studies, complicating inter-annual comparisons. An attempt to standardize the data from different years for comparison was made by only including data from August 15 to October 15, which is the only time period overlapping between all sampling years (Table 7). Even in this window, however, there were differences in trap operating days between years. Another difficulty in comparing data year to year is the association between storm events and run timing. Storm events can trigger migration, so migration timing is variable between years.

Table 6: Guadalupe River adult Chinook salmon up-migrant trapping results.

Water Year	Date	Number Caught	Operating Days	Catch per Day
1998	October 1 - January 28	33	52	0.63
1999	July 16 - January 15	84	163	0.52
2000	August 13 - October 2	40	50	0.80
2001	August 17 - October 10	13	54	0.24
2002	September 12 - November 24	49	73	0.67
2004	August 19 - November 28	104	93	1.12
2006	October 6 - November 28	36	46	0.78

*No data was collected in 2003.

Table 7: Guadalupe River adult Chinook salmon up-migrant trapping results for August 15-October 15.

Water Year	1998	1999	2000	2001	2002	2004	2006
# Chinook	**6**	**48**	**40**	**13**	**18**	**39**	**3**
Operating Days:	9	61	48	54	33	57	9
CPUE	0.66	0.79	1	0.24	0.55	0.68	0.33
Pre-Project Average Operating Days: 43					**Post-Project Average Operating Days: 33**		
Pre-Project CPUE Average: 0.67					**Post-Project CPUE Average: 0.52**		

Even with the variations in operating days, pre- and post-Project comparisons are feasible and appropriate. The average pre-Project catch per unit effort (CPUE) between August 15 and October 15 was 0.67 Chinook salmon, with an average operating period of 43 days. The average post-Project CPUE was 0.52 Chinook salmon, with an average operating period of 33 days (Table 7). Even with the discrepancy between operating days, the number of Chinook salmon captured is indicative that Chinook salmon migration and spawning on the Guadalupe River are consistent with pre-Project conditions.

A comparison of the Chinook salmon spawning datasets (presented in the previous section) and up-migrant trapping results was done for each comparable year to further evaluate the utility and appropriateness of the datasets used to evaluate the MO. As would be expected, in years with higher CPUE at the up-migrant trap, a higher number of redds was detected (Figure 4). The regression analysis yielded an $R^2=0.63$, indicating a moderate level of fit associated with the trendline. The Figure 4 regression includes the WY 2000 redd survey data, which notably reduces the fitness of the line. When that WY is not included, the regression analysis yields an $R^2=0.90$, indicating a high level of fit. This data comparison improves confidence that spawning survey and up-migrant trapping is accurately following trends of Chinook salmon occurrence in the watershed, but again, is not accounting for all the fish returning and is not a representation of the population numbers.

The up-migrant trapping was not designed to compare pre- and post-Project data. It was largely a pilot study to determine run timing and assess fish passage conditions in the Guadalupe River watershed. As such, and due to the variations in level of effort and seasonal timing, the up-migrant trapping effort generally provides a line of evidence that Chinook salmon remained in the Guadalupe River watershed post-Project, and that the highest number of fish captured occurred post-Project. The up-migrant trapping data also helps to validate the redd survey effort. The correlation between these two survey efforts further strengthens the line of evidence associated with the spawning surveys.

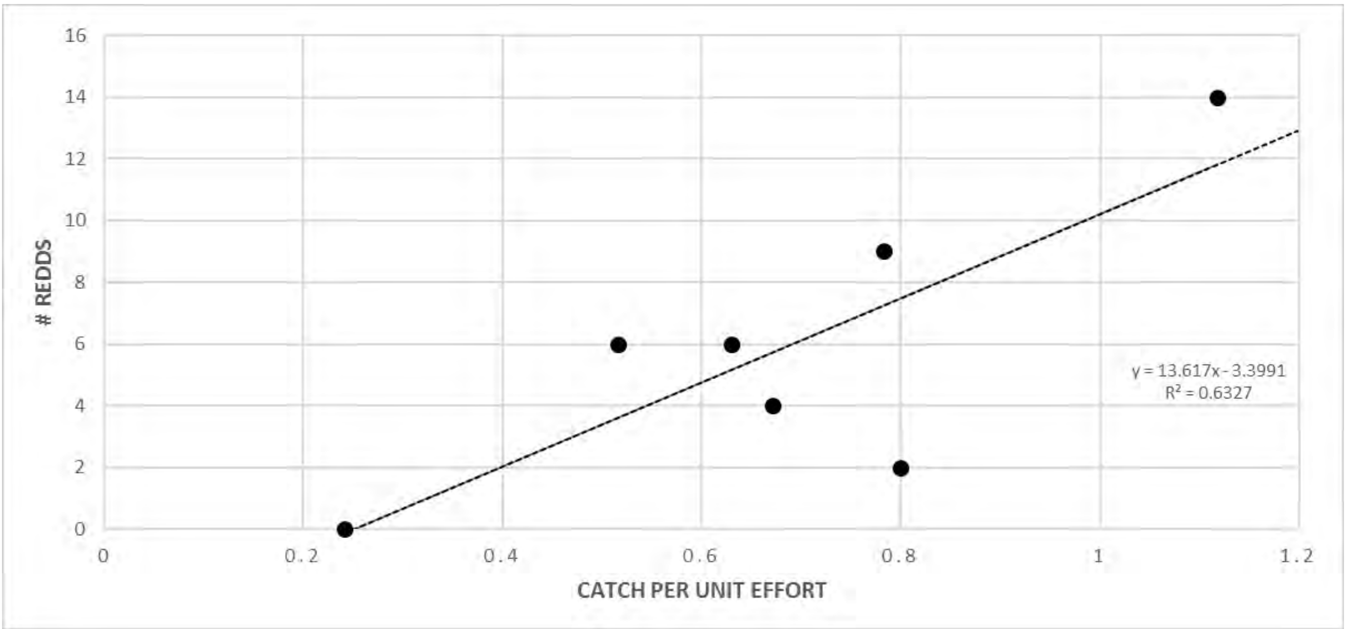

Figure 4: Guadalupe River adult Chinook salmon up-migrant trapping catch per unit effort compared to number of redds in WYs 1998-2002, 2004, and 2006.

Vaki Riverwatcher (VR)

A passive monitoring station fitted with an automated camera/infrared scanner, called a Vaki Riverwatcher (VR), was installed on the Alamitos Fishway (upstream of the Project) and recorded adult fish passage through the fishway in WYs 2004-2006 (Nishijima et al. 2009). The VR logs the occurrence of up and downstream movement of fish by recording video 24 hours a day and uses infrared scanning to produce high quality silhouette images that can be used to identify, measure, count, and record run timing. The purpose of the VR was not to estimate population, but to determine the feasibility of adult fish passage through the fishway per the mitigated negative declaration for the Alamitos Fishway project. The VR documented at least ten adult Chinook salmon that migrated above the Project in each year of monitoring (Table 8). This system was not available pre-Project, so no pre-and post-Project comparisons can be made based on this monitoring system. However, the VR data indicates that adequate passage was available through the Project, post-Project, and that range expansion occurred after installation of the fishway.

Table 8: Vaki Riverwatcher Chinook salmon detections at the Alamitos Fishway in WYs 2004 to 2006.

Water Year	Months of Operations	Chinook Salmon Observation
2004	October-January	22
2005	October-April	27
2006	November-April	11

When detection data at the Alamitos Fishway is compared to the spawning surveys, it becomes more apparent that the spawning surveys do not account for all fish that moved upstream into Alamitos and Guadalupe Creeks each year. In WY 2004, 22 Chinook salmon were identified passing through the VR at the fishway. In the same year, seven redds were observed in Guadalupe and Alamitos Creeks. In WYs 2005 and 2006, 27 and 11 Chinook salmon were identified passing through the VR at the fishway, respectively, yet only one redd was observed upstream of the fishway in each of those years. The spawning surveys in Guadalupe Creek cover 31% of available habitat (in approximately the lower third of the creek) and in Alamitos Creek cover 26% of the available habitat (in approximately the lower quarter of the creek and none of Calero Creek). The comparison with the VR data indicates that Chinook salmon are using habitat upstream of the areas covered during the spawning surveys, and that migration and spawning monitoring underestimates the total number of Chinook salmon migrating upstream to Alamitos and Guadalupe Creek. The data from the VR provides a more accurate estimate of adult fish migrating upstream of the Project than the spawning surveys, but there are flow and water clarity limitations with the VR that can also lead to an underestimation of adult fish abundance. During high flows, turbid conditions limited the effectiveness of identifying fish using both the recorded video and the generated silhouettes. The high flows also created opportunities for adult Chinook salmon to jump over the scanner, thus evading detection. Other limitations associated with the VR include the orientation of the fish as it passes through the infrared scanner plates. The detections of Chinook salmon presented by Nishijima et al. (2009) are detections with high confidence based on timing and physical characteristics. Other Chinook salmon may have passed through the VR, but a high-confidence identification could not be made so they were not included in the analysis.

The VR data provides solid evidence that Chinook salmon are migrating through the Project, are navigating the fishway, and that the spawning surveys are not accounting for all the Chinook salmon that return to the watershed. Since it may miss detections during high flows or if fish pass through the scanner at an obscure angle, the VR data may also underestimate fish passage and present a conservative assessment of Chinook salmon abundance.

4. Central Valley Fall-run Chinook Salmon Escapement

Variability in Chinook salmon spawning is evident in the 19-year survey dataset (WY 1995-2014) available for the Guadalupe River watershed (Table 3). This is expected for species like Chinook salmon, which have freshwater and marine life history stages. Many variables, such as ocean temperatures, upwelling, and marine food production, are associated with success of the species outside of their freshwater life stages, which are relatively brief periods in their life span. Year to year occurrence fluctuations based on these ocean conditions are common and likely not a result of the Project, or even Guadalupe River watershed conditions. To understand fluctuations not associated with the Project, Guadalupe River watershed spawning survey results (data from Table 4) were compared with Central Valley Fall-run Chinook escapement (number of adult salmonids returning to freshwater river systems) data (CDFW 2016). This dataset is an estimate of total run escapement derived from counts of fish entering the hatcheries and migrating past dams, carcass surveys, live fish counts, and ground and aerial redd counts (CDFW 2016). Though this dataset differs greatly in magnitude and data collection method from the Project spawning surveys, it provides a comprehensive trend for comparison. The Central Valley dataset shows extensive population fluctuation over the 19-year period (*Range (R)*=819,540; *Standard Deviation (SD)*=195,103). This high level of variability each year was also observed in redd occurrences in the Guadalupe River watershed (*R*=34; *SD*=9.04), but due to the four orders of magnitude difference in scales (100,000s of fish in the Central Valley dataset versus 10s of fish in the Guadalupe River watershed dataset), it is challenging to visually compare. When the ratio of range to standard deviation is compared, similarities between the Guadalupe River watershed (*R/SD*=3.8) and Central Valley (*R/SD*=4.2) can be seen (Figure 5). Yearly fluctuations of redd occurrence in the Guadalupe River watershed follow similar trends to Central Valley Fall-run stocks, with the same peak in 2003 and a substantial decline in WYs 2009 and 2010 (Figure 5). The overall linear trend of both datasets is declining, with the Guadalupe River watershed declining at a much lower rate (but this likely reflects the smaller size run). The post-Project monitoring period coincided with a major decline in Chinook salmon abundance statewide. The decline that occurred in WYs 2008 to 2010 resulted in the California Fish and Game Commission instating an emergency closure of commercial and recreational salmon fishing for two years for the entire state. According to Lindley et al. (2009), this decline was a result of ocean conditions, as the freshwater conditions were not unusual, and broods were at a normal level. It is believed that poor ocean conditions, including weak upwelling and warm sea temperatures, resulting in low forage levels when fish left natal streams to age two caused a substantial portion of the ocean population to perish. These poor ocean conditions affected more than just salmon, with declines observed in pelagic seabirds with diets similar to Chinook salmon. The ocean life phase of anadromous fish plays an important role in individual survival and population levels, and thus must be taken into consideration when evaluating and understanding freshwater life stage population fluctuations.

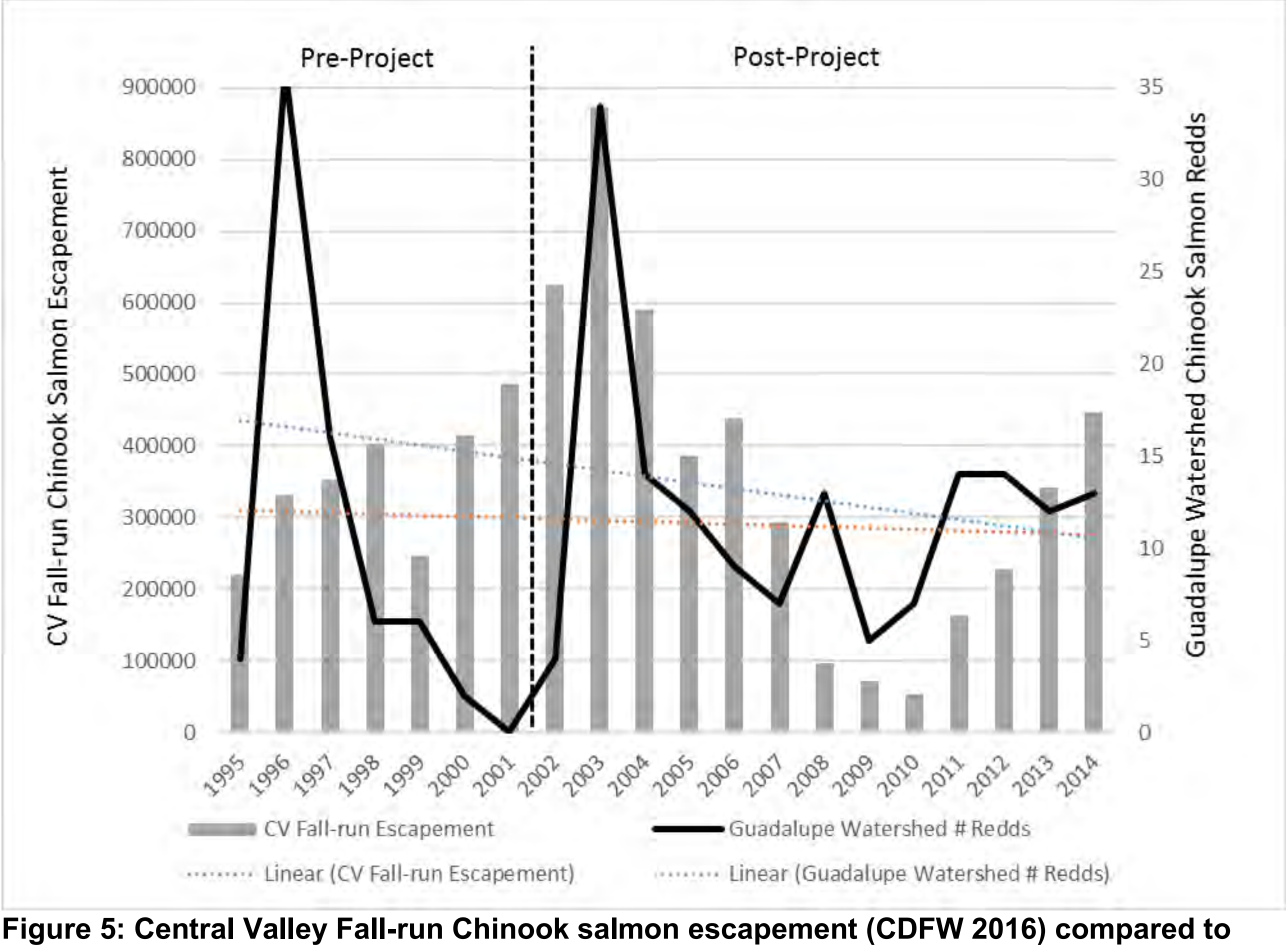

Figure 5: Central Valley Fall-run Chinook salmon escapement (CDFW 2016) compared to Guadalupe River watershed redd survey data in WYs 1995 to 2014.

Though the Guadalupe River watershed data deviated from Central Valley escapement in some years (WYs 1996, 2000-2002, and 2008) during the 19-year analysis period, very similar fluctuations occurred overall. Deviations are expected as the magnitude of the runs differ, data collection methods are not standardized, and the rates of straying (the source of the Guadalupe River watershed Chinook salmon population; see Appendix A) vary year to year. What this comparison does suggest is that other variables outside of the Project contributed to variations in pre- and post-Project spawning results, and supports the genetic findings that the source population for Chinook salmon in the Guadalupe River watershed is Central Valley Fall-run. This comparison also suggests that monitoring Chinook salmon spawning may not be accurately capturing what is occurring with the Guadalupe River watershed population. Return, or escapement, numbers are not necessarily indicative of freshwater conditions, since the time Chinook salmon spend in freshwater is only a fraction of their life. Most of the life span of these fish is spent in the ocean, outside the influence of watershed conditions such as the Project. This line of evidence elucidates the trends associated with the Chinook salmon population and demonstrates that ocean conditions strongly influence population fluctuations in the watershed.

CONCLUSION

SCVWD is requesting an end to one of many monitoring indicators for the downtown Guadalupe River Project: anadromous fish occurrence, adult migration and spawning. The downtown Project adequately disclosed, avoided, minimized, and mitigated impacts to anadromous Chinook salmon to the extent possible as verified by monitoring results, and other analyses presented in this report. The indicator was monitored for 14+ years, more than 40% longer than the 10-year duration specified in the MMP. The SCVWD concludes that the MO for the anadromous fish occurrence, adult migration and spawning indicator has been met, and can be considered completed in compliance with the downtown Guadalupe River Project's RWQCB Order, BOs, and MMP.

The MO has been met

This multiple lines of evidence report presents the best available, most complete, and scientifically valid evidence that the Project anadromous fish occurrence, adult migration and spawning monitoring MO is met: *The Guadalupe River must continue to support migration and spawning of adult steelhead and Chinook salmon at a level that is consistent with pre-Project conditions and environmental conditions not affected by the Guadalupe River Project*. When spawning surveys are compared pre- to post-Project, data demonstrates that the Guadalupe River continues to support migration and spawning of Chinook salmon at a level that is consistent or greater than pre-Project conditions, even during a time of statewide Fall-run Chinook salmon population decline. Therefore, monitoring of this indicator should be deemed complete for the Project.

The multiple lines of evidence presented in this report include:

1. Fish passage improvements resulted in range expansion that doubled the available habitat for salmonids. In addition, continual fish passage barrier remediation will occur through the hardscaped reaches of the Project for the life of the Project.

2. When comparable spawning survey data (redds, live adults, and carcasses) are analyzed, there is no change from pre- to post-Project, and evidence of range expansion due to passage barrier remediation is seen (see Table 5).

3. Additional up-migrant trapping and VR monitoring indicates Chinook salmon successfully passed upstream of the Project in all years of monitoring and that post-Project Chinook salmon levels were higher than pre-Project. The additional monitoring data also corroborates and sheds additional light on the spawning survey data.

4. Chinook salmon occurrences in the Guadalupe River watershed follow similar trends as Central Valley Fall-run escapement, indicating other environmental variables outside of the Project have an influence on returning fish.

Historical data and hydraulic conditions suggest Chinook salmon were not historically present in the Guadalupe River watershed (Appendix A). Currently, however, Chinook salmon are present and persist in the watershed post-Project every year flow conditions have allowed. DNA testing concluded that these fish are not genetically distinct and are hatchery strays from the Central

Valley (Garcia-Rossi and Hedgecock 2002); therefore, any Chinook salmon presence today is greater than historical conditions.

The monitoring commitment has been met

The Science Panel of AMT-approved consultant and SCVWD scientists deemed the adult fish occurrence and migration MO language unclear and concluded that it was difficult to determine whether it had been met. They recommended that the MO not be used to determine compliance because it is too hard to isolate project impacts from environmental (see Appendix P of the WY 2010 MMR, SCVWD and H.T. Harvey and Associates 2011). Based in part on this recommendation, the AMT achieved consensus in 2010 to discontinue steelhead monitoring under this MO, since the juvenile rearing monitoring provided more useful results (recommendation 118). However, consensus was not reached in regard to Chinook salmon monitoring. Difficulties interpreting the MO for Chinook salmon is not sufficient justification for monitoring indefinitely.

The original MMP schedule required monitoring for adult migration and spawning twice a month in October and November for Chinook salmon and February through mid-April for steelhead prior to construction of the Project and for the first 10 years following construction. This equates to a total of 140 surveys. Monitoring for Chinook salmon was conducted per the MMP's standardized methods and AMT-approved variations thereof, from WY 2002 to 2014. SCVWD increased the monitoring effort beyond the Downtown Project reaches to include Guadalupe Creek, Los Gatos Creek, Alamitos Creek, and upper Guadalupe River reaches watershed-wide to better evaluate the resources. SCVWD ultimately conducted over 400 surveys, covering 1,000 river and creek miles during a 14-year monitoring period. Although the MMP states that the duration of monitoring may be reassessed by the AMT during the life of the Project, it is clear that the monitoring has greatly exceeded the 140 surveys and 10-year requirements in the MMP, and that the resource agencies and SCVWD agreed to, in good faith, the terms and conditions of various Project permits.

Other relevant monitoring will be continued

Over the years, SCVWD has conducted monitoring in addition to the required Project monitoring to better understand Chinook salmon adult migration and spawning. These efforts included the installation of a VR fish counter and adult up-migrant trapping. In addition, SCVWD remediated 14 anadromous fish passage impediments, restored the Guadalupe River Reach A and lowest reaches of Guadalupe Creek, doubling the available habitat for salmonids.

For the life of the Project (100 years), SCVWD will continue to monitor depth, velocity, and vertical barriers to fish passage within the hardscaped reaches as described in the MMP and Fish Barrier Removal Protocol (Appendix C). This includes sediment removal within the low flow channel of portions of Reach 3. This monitoring ensures passable conditions and allows SCVWD to remediate barriers as they occur. This and other Project monitoring indicators, as well as SCVWD's Stream Maintenance Program, put fisheries biologists in the field inspecting for passage impediments throughout the up-migration season for both steelhead and Chinook salmon. During these efforts, observations of steelhead and Chinook salmon will be noted.

SCVWD also plans to continue juvenile rearing sampling for *O. mykiss*. The required 10 years of juvenile rearing monitoring for the downtown Projects was completed in WY 2013. Per an AMT-approved recommendation, however, monitoring will continue in the Guadalupe River watershed. SCVWD is working on obtaining permits to expand the Project monitoring to other streams within the Guadalupe River watershed to better evaluate *O. mykiss* reproduction. The sampling timeframe does not overlap with the presence of juvenile Chinook salmon, but the presence and abundance of *O. mykiss* during the sampling can be used as an indicator of the suitability of habitat conditions for both salmonids.

Ancillary fish occurrence data is collected by the SMP and the Fisheries Aquatic Habitat Collaborative Effort (FAHCE). For example, as a part of FAHCE another VR has been installed at the Alamitos Fishway. In addition, CDFW and NMFS biologists, combined with public observations, will help record Chinook salmon status in the Guadalupe River watershed.

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Appendix A

Historical Occurrence of Chinook Salmon (*Oncorhynchus tshawytscha*) in the Guadalupe Watershed, Santa Clara County, California

Historical Occurrence of Chinook Salmon (*Oncorhynchus tshawytscha*) in the Guadalupe River Watershed, Santa Clara County, California

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COVER PHOTOS: Adipose fin-clipped (hatchery) Chinook salmon on the Guadalupe River captured during up-migrant trapping in 2003.

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Introduction

Based on the information compiled and reviewed in this report, Chinook salmon are unlikely to have been a historically persistent native species in the Guadalupe River watershed. Rather, Chinook salmon in the watershed are, or are descended from, hatchery-raised fish that strayed into the Guadalupe River relatively recently and now persist due to altered hydrology. This report provides an overview of Chinook salmon life history for context and presents the genetic analysis and hatchery-related information, historical and contemporary hydrologic analysis, and historical records that form the basis of this conclusion.

Chinook Salmon Life History

During the ocean phase of their life history, Chinook salmon, often called king salmon, are distributed in the Pacific Ocean from Kotzebue Sound, Alaska in the north to as far south as Monterey Bay, California. There are 17 Chinook salmon “ecologically significant units” (ESUs) along the west coast from California to Canada (NMFS 2005). The southernmost spawning runs occur in California’s Central Valley and include naturally-spawned Chinook salmon in the San Joaquin and Sacramento River watersheds east of Carquinez Strait, California (NOAA 2010). Chinook salmon are not known to have historically spawned in streams flowing into South San Francisco Bay (H.T. Harvey and Associates 2005), but now occur in some Santa Clara Valley watersheds, including the Guadalupe River.

Chinook salmon in the Central Valley ESU occur in four distinct runs: fall, late-fall, winter, and spring. Genetically, Chinook salmon sampled in Santa Clara Valley creeks are most closely related to Central Valley fall-run ESU fish (Garcia-Rossi and Hedgecock 2002), and the timing of Chinook salmon migration in the Guadalupe River watershed is most consistent with a fall run. Fall-run Chinook salmon are ocean-maturing salmon that spawn in lowland reaches of large rivers and, to a lesser extent, upper tributaries. From the ocean, fall-run Chinook salmon migrate as adults upstream to their natal stream from June through December (peaking from September to October) and spawn from late September through December. After juveniles emerge from spawning beds (redds) they typically have a stream residency of 1-7 months (Moyle 2002).

The fall-run is historically the most abundant of the Central Valley Chinook salmon ESU, having the greatest tolerance for a range of environmental conditions. Due to concerns over the wild population size and hatchery influence, Central Valley fall/late fall-run Chinook salmon are recognized as a Species of Special Concern by the California Department of Fish and Wildlife (CDFW). They are not currently listed under either the federal or California Endangered Species Act (CDFW 2017).

Hatchery Production and Genetic Analysis

In addition to wild populations, fall-run Chinook salmon are raised at 5 Central Valley hatcheries that release more than 32 million smolts each year (CDFW 2017; Palmer-Zwahlen and kormos 2015). Hatchery production of Chinook salmon began as a mitigation tool for habitat loss due to the construction of dams in the 1950s. These hatcheries use artificial propagation and release the fish into rivers, Sacramento-San Joaquin River Delta (Delta), and San Francisco Bay to continue their life cycle. Research indicates that a major loss of hatchery fish occurs between their release point and the ocean. A variety of factors can contribute to this loss, many of which are associated with anthropogenic changes to the environment in the Delta, such as water diversions and increased predation rates due to habitat alterations and nonnative species. To ameliorate these negative effects associated with the Delta, resource agencies began trucking fish around problem areas in the 1970s. Since as early as 1976, and with an increase in effort in 1978-1979, resource agencies have been experimenting with net-pen rearing directly in the San Francisco Bay (Leet et al. 1986), and even more recently directly into the ocean (Palmer-Zwahlen and Kormos 2015).

Chinook salmon may stray, meaning return from the ocean to a river that is not their natal stream to spawn (Moyle 2002). This trait is exacerbated in hatchery-origin fish, which stray at a higher rate than wild Chinook salmon (Quinn 1993, Ford et al. 2015). This increased straying tendency is observed even when just one of the parents is of hatchery origin (Ford et al. 2015). The practices of trucking and net-pen rearing further weaken the homing imprint for Chinook salmon to return to their natal stream (CDFG and NMFS 2001). When straying occurs, even in wild populations, it can decrease the overall fitness of the population by eliminating local adaptive advantages, particularly in small populations. Straying may also cause fish to end up in less than ideal habitats (Bett et al. 2017). Because interbreeding with hatchery fish can reduce the fitness of wild populations, straying of hatchery-produced salmonids can be detrimental. Straying can also be detrimental at the individual level, as strays have a higher mortality rate compared to natal salmon, which have adapted to local conditions (Quinn 1993). Alternatively, straying may benefit some declining recipient populations (Bett et al. 2017) and potentially lead to the colonization of new habitats where conditions are suitable (Quinn 1993).

To understand the origins of Chinook salmon, genetics of fish captured in the Guadalupe River watershed were analyzed and compared to known haplotypes, including hatchery-raised fish. The initial study, conducted by Nielsen (1995) on 29 Chinook salmon from the Guadalupe Watershed, found that fish of Central Valley fall-run and hatchery origin were present in the Watershed, but that 8 fish did carry what were thought to be unique haplotypes. A subsequent study, conducted in 2002 with more advanced DNA analysis, tested over 450 Chinook salmon captured in Santa Clara Valley, including the same 29 fish in the Nielsen (1995) study. This study determined that the fish were most closely related to Central Valley fall-run Chinook salmon and that all fish and haplotypes identified by Nielsen (1995) were assigned to the Central Valley fall-run (Garcia-Rossi and Hedgecock 2002). Garcia-Rossi and Hedgecock (2002) further found that there was minimal heterogeneity and genetic divergence between Chinook salmon in the Guadalupe River watershed, and that Chinook salmon sampled in Santa Clara Valley creeks are most closely related to Central Valley fall-run ESU fish raised in the Feather River Hatchery (Garcia-Rossi and Hedgecock 2002). The presence of fin-clipped hatchery fish with coded wire tags in the Guadalupe River watershed also confirmed straying (Garcia-Rossi and Hedgecock 2002) and demonstrated a direct linkage to Central Valley hatcheries.

Historical and Contemporary Hydrology

Prior to the building of Guadalupe, Almaden, Calero, and Lexington reservoirs in the mid-1930s, the Guadalupe River watershed had a different flow regime than it does today. Indicated by flow data collected in the watershed by the United States Geological Survey (USGS), continuous connectivity from the upper watershed to San Francisco Bay was not common except during winter storms. The beginning of the perennial portion of the Guadalupe River was approximately 10 miles upstream of the bay, near the current community of Willow Glen in the City of San

Jose, where the intermittent tributaries Los Gatos Creek and Arroyo Seco de Guadalupe joined mainstem Guadalupe River. At this confluence, these tributaries spread into multiple channels on the silty clay soils, and high groundwater levels with slow draining soils contributed to the willow thickets and wetlands at the mouths of both creeks (Beller et al. 2010). Other than during large winter storms, these geomorphic conditions limited connectivity to the upper watershed, and historical maps show both Los Gatos Creek and Arroyo Seco de Guadalupe as unconnected tributaries (Beller et al. 2010). These conditions did support *O. mykiss*, which due to their polymorphic life cycle, could reside in the upper watershed when there was no hydrologic connectivity, rather than migrate to and from the ocean.

There is a historical record of a flour mill on the lower Guadalupe River, which would have required a reliable water source, and historical photographs that show the lower portion of the Guadalupe River as perennially wet (San Jose Public Library 1996). While this historical potentially perennial portion of the creek could have provided migration, and perhaps rearing, habitat for anadromous fish, the relatively fine substrate in this low-gradient, sinuous reach plus a lack of riparian cover (most of the reach is mapped historically as wet meadow; Beller et al. 2010) would not have supported Chinook salmon spawning. Thus, a critical part of their freshwater life cycle could not have been successfully carried out on the Guadalupe River. According to Hobbs et al. (2012), it is also unlikely that an anadromous salmonid population would have used the Alviso Marsh area at the confluence of the Guadalupe River and San Francisco Bay due to chronic year-round hypoxia that was documented as early as the early 1900s.

By 1899, the upstream tributary of Arroyo Seco de Guadalupe was channelized and connected to the mainstem of the Guadalupe River to form the Guadalupe River as it appears today (Beller et al. 2010). Historical flow data collected after this connection, in water years (WYs) 1930-1935 by USGS, showed little to no flow in the watershed between June and January (Figure 1; USGS 2016). The area of this historical dryback, which may have been exacerbated by over-pumping of groundwater, occurred over 8 miles between the Guadalupe River and the confluence with San Francisco Bay. This historic flow regime would have severely limited adult Chinook salmon upstream migration, which typically occurs from June through December (peaking from September to October), plus a portion of juvenile out-migration, which typically occurs December through March (Moyle 2002). Furthermore, this flow regime would have provided only a few miles of perennial wet habitat in the lower reaches of the river. It was not until the construction of Almaden (1935), Guadalupe (1935), Calero (1935), and Lexington (1952) reservoirs, which store water for release and groundwater percolation during the summer and fall, that flows in the watershed became consistently perennial during the Chinook salmon adult and juvenile migration periods.

It was not until the mid-1980s that Chinook salmon were documented in the Guadalupe River watershed (HRG 1995, Leidy 2007). This timing corresponds with the Central Valley hatchery production, trucking, and net-pen rearing done to reduce the impacts of Delta conditions on hatchery fish survival, which likely increased the tendency of Chinook salmon to stray (Leidy 2007, Smith 2013). The first documentation of Chinook salmon in the Guadalupe River occurred during the drought of 1987–1992 (Smith 1987). This coincides with a groundwater contamination remediation effort by the IBM Fairchild Corporation, which began in 1982 and involved pumping and releasing as much as 50 cubic feet per second (cfs) of clear groundwater continuously into Canoas Creek, a tributary to the Guadalupe River (Smith 1987). This amount of water may have served as a major attractive flow to straying Chinook salmon in a droughtstricken San Francisco Bay. Though the IBM Fairchild Corporation groundwater pumping has ceased, the Guadalupe River watershed experienced (and still experiences) other supplemental flows resulting from groundwater pumping from surrounding development. Buildings with basements and infrastructure at the San Jose International Airport and in downtown San Jose pump “nuisance” groundwater and release it as intermittent pulses of cool, clean water directly into the Guadalupe River (Leidy 2007; Smith 2013). These operations provide attractive flows in the lower portion of the watershed that were not historically present, especially during the Chinook salmon adult migration period when rainfall is absent or contributes very little to river flow. Attractive flows during the migration period, which were historically absent or limited to the latest portion of that period, coupled with the poor imprinting abilities of hatchery-raised fish provides a reasonable explanation for why and how Chinook salmon, which were previously undocumented, came to occur in the Guadalupe River watershed beginning in the 1980s.

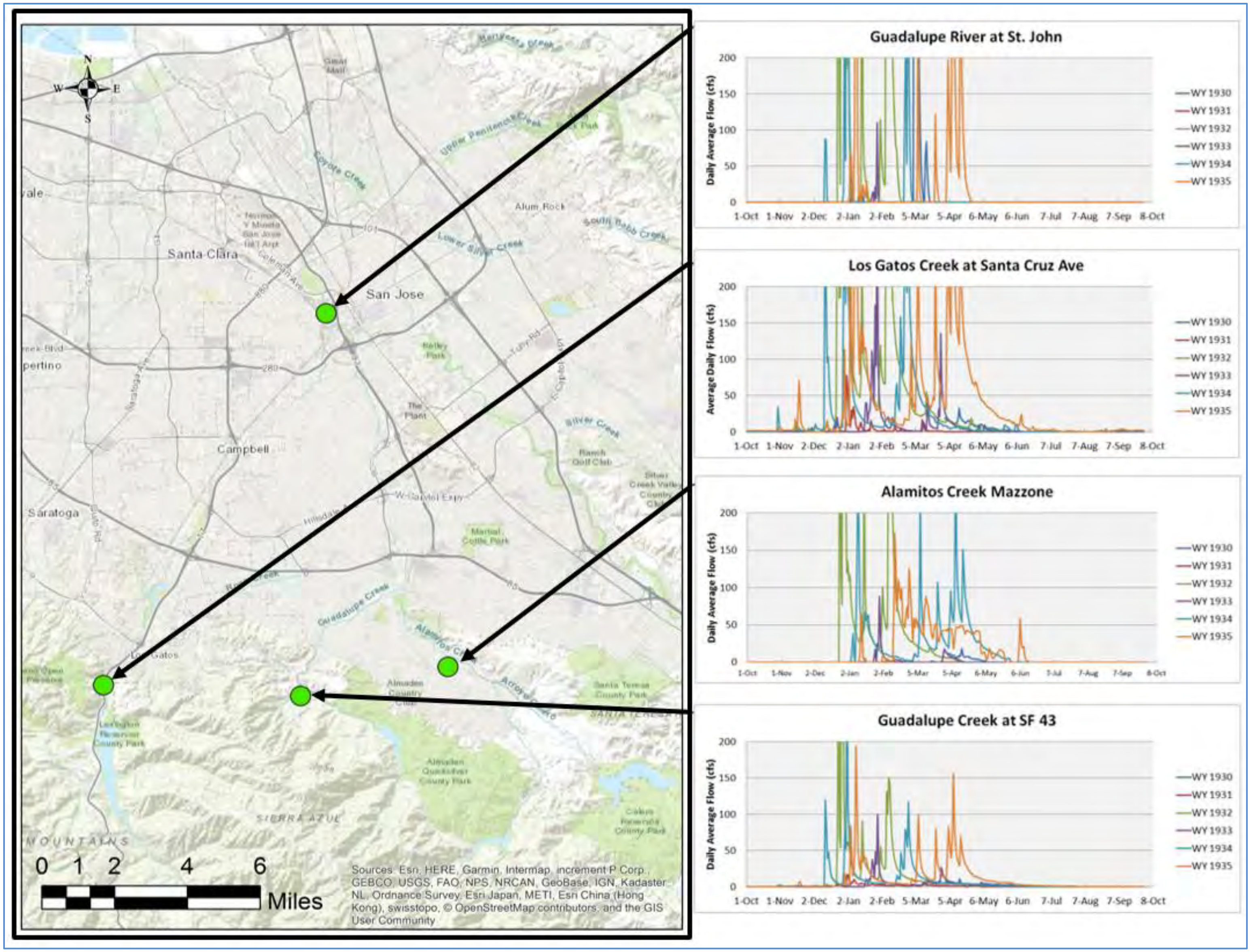

Figure 1: Historical flows in the Guadalupe River watershed from water years (WYs) 1930–1935 recorded at United States Geological Survey stream flow gages. Precipitation levels averaged 11.2 inches, similar to precipitation in WYs 2009–2014. Note that little to no flow occurred at any of these gages from June through December.

Historical Records of Fish Occurrence

Research from the late 1800s to mid-1900s, and subsequent scientific accounts, did not document Chinook salmon in the Guadalupe River. James Snyder, Assistant Professor of Zoology at Stanford University, was one of the first researchers to record the fish assemblages in Santa Clara County in 1904 (Snyder 1905). This research is the earliest documented scientific study recorded in the county. Snyder determined that 13 species of fish were present in Santa Clara County tributaries of San Francisco Bay, with only 5 of those species occurring in the Guadalupe River watershed (Table 1). Subsequent studies conducted by Hubbs in 1924, Fry in 1936, Taft and Shapovalov in 1937, Merkel in 1953, CDFG in 1975, and Leidy in 1981 (all as cited in Leidy 1984) provided similar results, with an observed increase in nonnative species after the 1953 survey (Table 2). Information on methods and sampling timing is limited for these studies, but Leidy (1984) inlcudes an appendix that shows some sampling dates for when specific species were encountered. Sampling in the Guadalupe Watershed did occur in months when Chinook Salmon could have been present, but the species did not appear in any of this historical literature.

Table 1: Fish documented in the Guadalupe River watershed in 1904 (Snyder 1905).

Common Name	Scientific Name*
Rainbow Trout/Steelhead	*Oncorhynchus mykiss*
Sacramento Sucker	*Catostomus occidentalis*
California Roach	*Lavinia symmetricus*
Three-spined Stickleback	*Gasterosteus aculeatus*
Prickly Sculpin	*Cottus asper*
*Scientific names have been changed to match modern nomenclature.	

Table 2: Fish documented in the Guadalupe River watershed from 1895 to 1981 (Leidy 1984).

Common Name	Scientific Name	1895	1922	1936	1937	1953	1971	1981
Native Species								
Rainbow Trout/Steelhead	*Oncorhynchus mykiss*	x				x		x
Sacramento Sucker	*Catostomus occidentalis*	x	x			x		x
Sacramento Pikeminnow	*Ptychocheilus grandis*		x					
California Roach	*Lavinia symmetricus*	x	x	x	x	x	x	x
Three-spined Stickleback	*Gasterosteus aculeatus*	x	x	x	x			
Prickly Sculpin	*Cottus asper*	x				x		x

Riffle Sculpin	*Cottus gulosus*					x	x	x
Non-native Species								
Goldfish	*Carassius auratus*						x	x
Common Carp	*Cyprinus carpio*							x
Golden Shiner	*Notemigonus crysolecus*							x
Brown Bullhead	*Ameiurus nebulosus*							x
Inland Silverside	*Menidia beryllina*							x
Rainwater Killifish	*Lucania parva*							x
Mosquitofish	*Gambusia affinis*					x	x	x
Largemouth Bass	*Micropterus salmoides*							x
Smallmouth Bass	*Micropterus dolomieu*							x
Green Sunfish	*Lepomis cyanellus*							x
Redear Sunfish	*Lepomis microlophus*							x
Pumpkinseed	*Leopmis gibbosus*							x
Bluegill	*Lepomis macrochirus*						x	
Black Crappie	*Pomoxis nigromaculatus*							x

The data collected over the 86-year span presented in Table 2 indicate that 7 native species were consistently observed. Chinook salmon were not recorded during any of the collection efforts. A historical review of freshwater fish of San Francisco Bay conducted by CDFW in 1962 also did not indicate Chinook salmon were present within the Guadalupe River and cites many of the papers included in Table 2 (Skinner 1962).

In a follow up to the 1984 publication, Leidy wrote a review of the watersheds of the San Francisco Bay Estuary (2007). This document includes a table that reports the fish species present in Santa Clara County and does list Chinook salmon as a “native” species. The information in the table is based on sampling efforts conducted by Leidy as well as data and historic accounts collected from various sources (scientific and non-scientific). Although the table indicates that Chinook salmon are native to the Guadalupe River, the in-text discussion indicates that these fish are of hatchery origin and were not detected until the 1980s, coinciding with changes to hatchery release points (Leidy 2007). The reasoning for the classification of these fish as native is not clear. This same report also indicates that American shad (*Alosa sapidissima*) are native to the Guadalupe River watershed, when this fish is not native to any portion of the western United States (Moyle 2002).

More recently, in 2013 the National Oceanic and Atmospheric Administration (NOAA) released salmon and steelhead distinct population segment (DPS)/ESU maps illustrating historical and current Chinook salmon freshwater range, including portions naturally or anthropogenically blocked (Figure 2). Santa Clara County is not included in the historical or current ranges for the Central Valley fall-run and late fall-run ESU (NOAA 2013). In addition, a search conducted through the California Academy of Sciences (CAS) Ichthyology Collection Database on April 10, 2018 did not return any records of Chinook salmon from the South Bay. Most records are from the Sacramento and San Joaquin Rivers, consistent with other historical data. The CAS

Department of Ichthyology holds one of the largest research collections in the world, including historic North American collections, with approximately 1.2 million specimens (CAS 2018).

A study conducted by Gobalet et al. (2004) on piscine archaeological records of California evaluated historic distributions of freshwater and anadromous fish. This study evaluated fish remnants from Native American archeological sites and did not find any Chinook salmon elements within Santa Clara County, but did find elements of *O. mykiss*. This study included only one site on the Guadalupe River watershed, but no Chinook salmon were discovered within that effort. In contrast, Chinook salmon remains were recovered in areas with known occurrences of these fish, such as the Sacramento River drainages.

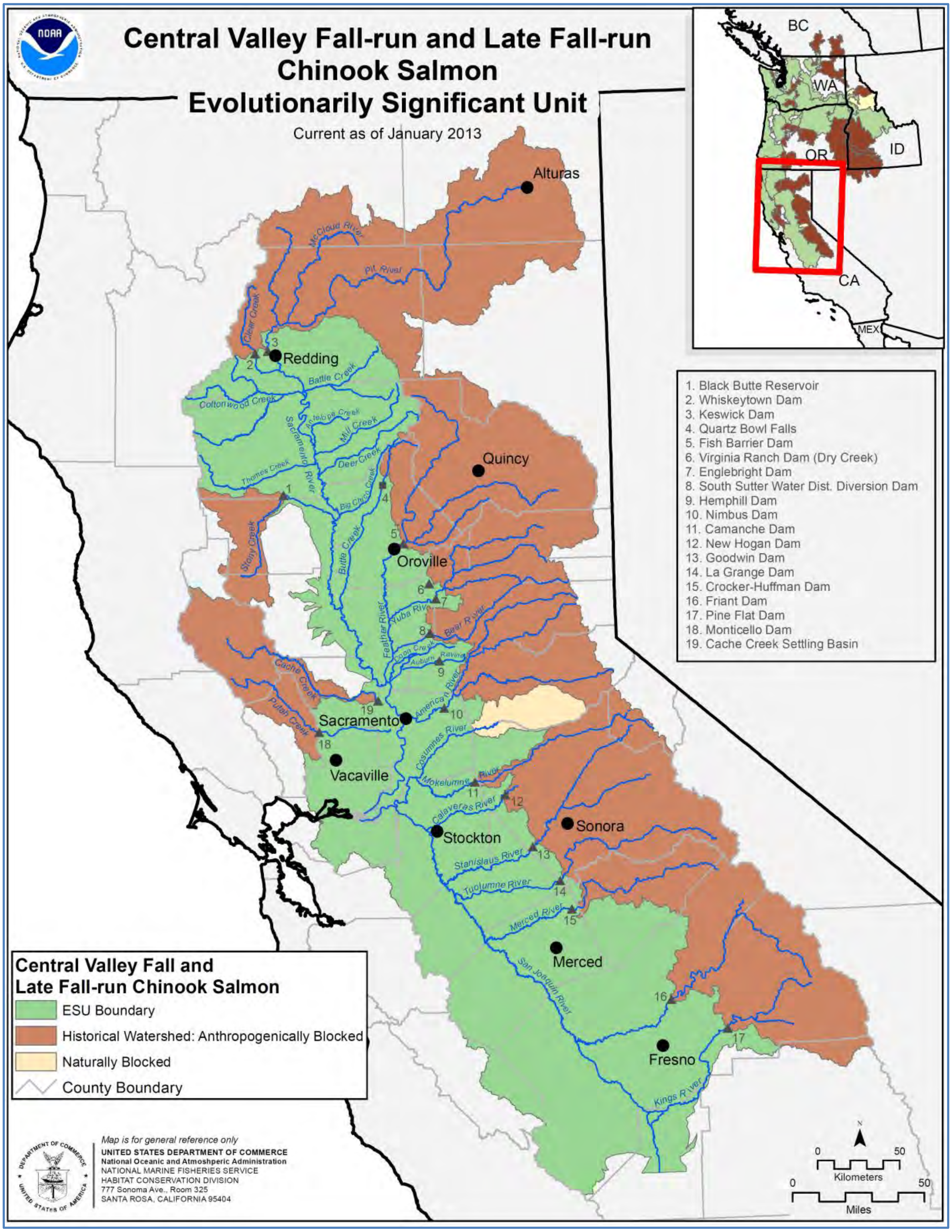

Figure 2: Central Valley Fall Run and Late Fall Run Chinook Salmon Evolutionary Significant Unit map created by the National Oceanic and Atmospheric Administration. No habitat is mapped, historic or current, in Santa Clara County.

While the available scientific evidence shows that it is unlikely Chinook salmon were historically present in the Guadalupe River watershed and genetic analysis confirm the fish currently present are Central Valley fall-run stocks (predominantly hatchery fish), there is anecdotal information from newspapers and personal accounts of salmonids that could be perceived as Chinook salmon pre-1980s. The terminology used by the authors of this nonacademic literature with no professional fisheries experience, may be the source of confusion. An article written in 1848 in the *California Star* newspaper stated that San Jose's water "…abounded with salmon trout…" The word "salmon" today could be interpreted to mean true salmon based solely on the name; however, nomenclature from that time period suggests otherwise. "Salmon trout" was the name used by Lewis and Clark (1806) during the first writing about steelhead (Moulton 1990). Moyle (2002) also provides a description of "salmon trout," which includes *O. mykiss* and cutthroat trout (*O. clarki*) in anadromous or resident form. Based on the fish surveys of the watershed, these fish were likely *O. mykiss*.

Another article from the *San Jose Daily Mercury,* written February 22, 1904, states "salmon and steelheads speared in local stream." Based on seasonality and the description of "large salmon" this is likely a misidentification, which is common in recreational fishing, and to some extent even commercial fishing. The late February timeframe associated with the article does not correspond with the seasonal migration of adult Chinook salmon (June through December; Moyle 2002). The silvery or chrome nature of adult steelhead returning fresh from the ocean can give the appearance of Chinook salmon. Skinner (1962) writes of how anglers often confuse salmon and trout species.

Other anecdotal evidence, such as photographs showing recreationally caught salmon, are available. One specific image shows A. O. Hale, a San Jose department store owner, with his catch of salmon in the 1890s. This image provides no evidence of where these fish were caught. When reviewing the source (Beilharz and DeMers 1980), no explanation associated with the fish accompanies the photograph, only a reference to the wealthy man next to the fish. This small collection of anecdotal information does not provide substantive evidence that these fish were native to any Santa Clara County drainage.

Conclusions

Based on the available scientific literature and lack of historical evidence, it is unlikely that the Guadalupe River watershed historically supported persistent populations of Chinook salmon. While there may have been a chance Chinook salmon would have had historical access to the lower portions of the Guadalupe River each year, historical flow conditions would not have provided consistent access to the upper watershed, making potential occurrence opportunistic and rare.

Chinook salmon and other anadromous salmonids (chum salmon (*O. keta*), pink salmon (*O. gorbushcha*)) have only been observed in Santa Clara County in the last 40 years. Genetic analysis has confirmed Chinook salmon of hatchery origin, which are supported by the watershed's altered hydrology that now has perennial flow in most years.

Although a definitive answer on the nativity of Chinook salmon in the Guadalupe River watershed cannot be made, this is the southernmost extent of the species' range, there is no substantial evidence of historical presence, historical flow conditions were not supportive, and the current population is of hatchery origin. Together, this body of evidence suggests Chinook salmon are not native to the watershed.

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Appendix B

Data Sources

Santa Clara Valley Water District Spawning Survey Data Water Year 1996-2000

Date	River/Creek	Landmarks	#Redds	#Live	#Carcass
9/18/1995	Guadalupe River	Trimble Road xing, downstream to Montague Expressway xing.	0	2	0
11/7/1995	Guadalupe River	Branham Way xing, downstream to Capitol Expressway xing.	0	1	0
11/8/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	8	3
11/9/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	6	0
11/9/1995	Guadalupe River	Branham Ave, upstream to Alamitos Drop Structure	0	0	0
11/14/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	3	2	7
11/16/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	1	1	3
11/21/1995	Guadalupe River	Branham Way xing, downstream to Capitol Expressway xing.	0	0	1
11/28/1995	Guadalupe River	Montague Expressway, upstream to Airport Blvd.	14	5	3
11/28/1995	Guadalupe River	Airport Blvd., upstream to Coleman Ave.	21	10	3
11/29/1995	Guadalupe River	Coleman Ave, upstream to St. John's St. xing	9	3	5
11/29/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	0	6
11/29/1995	Guadalupe River	St. John's St. xing, upstream to Grant Ave	2	3	4
11/30/1995	Guadalupe River	Grant Ave, upstream to Curtner Ave.	1	0	2
12/6/1995	Coyote Creek	Upstream of Highway 237 crossing, downstream of Montague Expressway crossing	0	0	0
12/7/1995	Coyote Creek	Upstream of Highway 237 crossing, downstream of Montague Expressway crossing	2	0	0
12/7/1995	Guadalupe River	Coleman Ave, upstream to St. John's St. xing	1	0	0
12/14/1995	Guadalupe River	Airport Blvd., upstream to Coleman Ave.	0	1	0
12/19/1995	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	3	0
1/4/1996	Guadalupe River	Branham Ave, upstream to Alamitos Drop Structure	2	1	1
1/5/1996	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	2	0	1
1/9/1996	Guadalupe River	Montague Expressway, upstream to Airport Blvd.	0	0	0
1/9/1996	Guadalupe River	Airport Blvd., upstream to Coleman Ave.	0	0	0
1/10/1996	Guadalupe River	Coleman Ave, upstream to St. John's St. xing	1	0	0
1/10/1996	Guadalupe River	St. John's St. xing, upstream to Grant Ave	0	0	1
1/10/1996	Guadalupe River	Curtner Ave, upstream to Branham Ave	3	0	8
1/10/1996	Guadalupe River	Alamitos drop structure, downstream to Branham Way xing.	0	0	0
1/12/1996	Los Gatos Creek	streamflow guage weir @ Lincoln Ave, upstream to Meridian Ave. xing.	0	0	1
3/28/1996	Guadalupe River	Branham Way xing, downstream to Capitol Expressway xing.	0	1	0
3/27/1996	Guadalupe River	Branham Way xing, downstream to Capitol Expressway xing.	0	1	0
7/31/1996	Guadalupe River	Montague Expressway, upstream to Airport Blvd.	0	0	0

Date	River/Creek	Landmarks	#Redds	#Live	#Carcass
10/24/1996	Guadalupe River	Airport Blvd., upstream to Coleman Ave.	4	0	0
10/30/1996	Los Gatos Creek	W. San Carlos, upstream to Meridian	0	1	0
10/30/1996	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	0	0
11/5/1996	Guadalupe River	Hwy 880 xing, downstream to Hwy 101 xing.	2	6	0
11/6/1996	Los Gatos Creek	Meridian Ave. upstream to Campbell Ave	33	40	9
11/6/1996	Guadalupe River	Airport Blvd., upstream to Coleman Ave.	10	0	0
11/7/1996	Los Gatos Creek	W. San Carlos, upstream to Meridian	5	4	3
11/8/1996	Los Gatos Creek	Campbell Ave., upstream to Camden	1	1	0
11/14/1996	Coyote Creek	at confluence with Upper Penetencia Creek	2	3	1

Date	River/Creek	Landmarks	#Redds	#Live	#Carcass
12/4/1997	Gualaupe River	Hwy 880 xing, downstream to Hwy 101 xing.	0	0	0
12/4/1997	Gualaupe River	Coleman Ave xing, downstream to Hwy 880 xing.	3	6	0
12/4/1997	Gualaupe River	Airport Blvd., upstream to Coleman Ave.	3	1	1
12/15/1997	Los Gatos Creek	streamflow guage weir @ Lincoln Ave, upstream to Meridian Ave. xing.	0	0	0
12/18/1997	Coyote Creek	Upstream of Highway 237 crossing, downstream of Montague Expressway crossing	0	0	0
12/19/1997	Gualaupe River	Hwy 280, downstream to Coleman Avenue xing.	0	0	1
12/22/1997	Gualaupe River	Alamitos drop structure, downstream to Branham Way xing.	0	0	0
12/26/1997	Los Gatos Creek	Stream Guage 50 at Lincoln Avenue, downstream to San Carlos Ave xing.	0	0	1
12/29/1997	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	0	0	0
12/30/1997	Coyote Creek	Upstream of Highway 237 crossing, downstream of Montague Expressway crossing	0	0	0
12/31/1997	Los Gatos Creek	Campbell Ave xing, downstream to Hamilton Ave. xing	0	0	1
12/31/1997	Los Gatos Creek	Camden drop structure, downstream to Campbell Ave xing	0	0	0
5/25/1998	Gualaupe River	upstream of Trimble Road crossing, downstream of Highway 101 crossing.	1	0	0

Date	River/Creek	Landmarks	#Redds	#Live	#Carcass
11/19/1998	Guadalupe River	Coleman Ave xing, downstream to Hwy 880 xing.	2	2	0
11/19/1998	Guadalupe River	Hwy 880 xing, downstream to Hwy 101 xing.	2	0	0
11/19/1998	Guadalupe River	Hwy 101 xing, downstream to Trimble Rd xing.	1	1	0
12/9/1998	Los Gatos Creek	Campbell Ave xing, downstream to Hamilton Ave. xing	1	0	0
12/9/1998	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	0	1	0
12/9/1998	Los Gatos Creek	Meridian Ave xing, downstream to Stream Gage 50 at Lincoln Ave xing.	1	2	0
12/10/1998	Guadalupe River	Curtner Ave xing, downstream to Hwy 280 xing.	0	0	0
12/13/1998	Guadalupe River	Hwy 280, downstream to Coleman Avenue xing.	0	0	0
1/4/1999	Guadalupe River	Curtner Ave, upstream to Branham Ave	0	0	0
1/4/1999	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	3	0	0
1/4/1999	Los Gatos Creek	Campbell Ave xing, downstream to Hamilton Ave. xing	4	0	0
1/4/1999	Guadalupe River	Alamitos drop structure, downstream to Branham Way xing.	0	0	0
2/4/1999	Los Gatos Creek	San Carlos Street xing, downstream to the confluence with Guadalupe River	0	0	0
3/30/1999	Los Gatos Creek	streamflow guage weir @ Lincoln Ave, upstream to Meridian Ave. xing.	1	0	0
3/31/1999	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	4	0	0
3/31/1999	Los Gatos Creek	Meridian Ave xing, downstream to Stream Gage 50 at Lincoln Ave xing.	2	0	0
3/31/1999	Los Gatos Creek	Stream Guage 50 at Lincoln Avenue, downstream to San Carlos Ave xing.	2	0	0
4/1/1999	Guadalupe River	Hwy 880 xing, downstream to Hwy 101 xing.	2	0	0
4/5/1999	Guadalupe River	Coleman Ave xing, downstream to Hwy 880 xing.	0	0	0
5/4/1999	Guadalupe River	Coleman Ave xing, downstream to Hwy 880 xing.	1	0	0

Date	River/Creek	Landmarks	#Redds	#Live	#Carcass
10/18/1999	Guadalupe River	Hwy 101 xing, downstream to Trimble Rd xing.	1	0	0
10/18/1999	Los Gatos Creek	Hamilton Ave xing, downstream to the Meridian Ave. xing.	2	0	0
1/13/2000	Guadalupe River	Coleman Ave, upstream to St. John's St. xing	2	0	0

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— Early Draft of Fisheries for Middle Guad Flood Control —
Tables 7, 8 — 1987 Chinook Depression
last page — Campto 1987

FISHERIES

Regional

The Bay Area originally had a fairly diverse assemblage of native fishes. Small streams may have had only several species, but larger river systems, such as Coyote Creek, contained up to 14 species. Within streams, diversity increased downstream as species were progressively added in response to an increased variety of microhabitats in downstream areas; the fast-water habitats of headwaters could still be found in scattered downstream riffles, but large, slow pools offered new conditions suitable for many current-intolerant species.

The urbanization of the valley floors has resulted in channel modifications for flood control in low-land areas and construction of reservoirs and water diversions in headwater areas. Water quality declines and water loss have resulted in severe depletion of native fish species, especially on the valley floors. Scoppettone and Smith (1978) and Aceituno, et. al (1976) documented the extensive losses of native fish species in Alameda and Coyote creeks, and Leidy (1984) documented losses throughout the San Francisco Bay Area. No fish species in the Bay Area is officially listed as rare or endangered, but many, especially low-land species, are extremely depleted throughout their range. One Bay Area fish, the thicktailed chub (Gila crassicauda) is now extinct, and another, the Sacramento perch (Archoplites interruptus) is being considered for rare listing because of rarity within its native range. Steelhead (Salmo gairdneri) and salmon (Oncorhynchus spp.) once were common in Bay Area streams, but streamflow and water quality declines, as well as flood control and diversion structures as barriers, have reduced or eliminated most runs. Now regular steelhead runs in the south bay may occur only in Coyote, San Francisquito and Alameda creeks.

The Guadalupe River watershed is relatively dry and intermediate in size; it originally contained 7-8 fish species, including steelhead. All original species still exist in the watershed, although rainbow trout are probably restricted to headwaters and runs of steelhead (anadromous rainbow trout) may no longer occur. King salmon (Oncorhynchus tshawytscha) were probably not native to south bay streams, but due to smolt releases into the bay and delta by the Department of Fish and Game, fish now ascend and spawn in some south bay streams, including the Guadalupe River and Coyote Creek.

Local

Because of fish movement and environmental influences from upstream, the description of local conditions and fish populations for the Guadalupe River includes upstream reaches and tributaries.

Methods:

Fish populations were sampled by backpack electroshocker during July, August, and September at 16 sites on lower Guadalupe River in 1986. Six of the sites were resampled and two additional sites sampled in June 1987 (Table F3). Seven sites were in the portion of the creek involved in the proposed city park, and 10 sites were upstream of West Virginia Avenue, in areas potentially affected by Santa Clara Valley Water District (SCVWD) flood control project planning. In November and December 1986, 6 additional sites were sampled in headwater portions of the Guadalupe River drainage (Table F4), upstream from SCVWD percolation ponds and an impassible (10 1/2 foot high) drop structure. At each site 2-4 individual pool, riffle, or run habitats were sampled to determine microhabitat utilization as well as fish species composition. Fish were measured or assigned to size groups, and the abundance ratings were separated for juvenile and adult fish where the two showed major differences in distribution or abundance (see Tables F3 and F4).

At each site the following environmental data were recorded: percent pools, riffles, and runs; channel and bank conditions; sources of major substrate size categories; extent and quality of spawning gravels; and estimated flow volume. In addition, the following environmental data were recorded for each microhabitat sampled: mean depth; percent abundance of size categories of substrate; escape cover type and abundance; overhead cover abundance; estimated mean daytime shade; algae abundance and distribution; type and distribution of aquatic vegetation; and a general food (invertebrates) rating for the riffle habitat. Maximum-minimum thermometers were placed at 9 of the fish sampling sites and at two other stations to determine water temperature ranges (Table F1). Thermometers were checked 2-3 times during the study; only partial data are available for 3 of the sites, as the thermometers were stolen. Temperature was also spot checked at the thermometer stations and at several other sites. Secchi depths (an estimate of the depth of light penetration) were determined twice at each of the thermometer stations. Dissolved oxygen was determined once for the thermometer stations (see Table F2 for secchi depths and dissolved oxygen levels).

In June 1987 the entire river was surveyed from Canoas Creek downstream to Highway 280 to determine habitat conditions. Relatively homogeneous stream segments were categorized as pool (deep, slow-water areas), run (relatively fast flow with unbroken surface), riffle (shallow, fast-water areas with broken surface) or mixtures, and segments were mapped on aerial photographs. Mean depth of the habitat segment was estimated. A mean shade value was also estimated for each habitat segment, based upon density and height of trees, their location on the banks, height and slope of banks, and the position of the summer sun. Areas of potential escape cover for fish, and spawning areas for salmon or steelhead were mapped. Number of actual spawning redds (nest depressions) was indicated at each site where spawning had apparently taken place. Stream surveys conducted by the Department of Fish and Game in 1987 recorded numbers of redds in Guadalupe River segments, including areas upstream and downstream of our survey (Stafford Lehr, personal communication). Their data are used for comparison. Potential steelhead and salmon rearing habitat was indicated on the aerial photographs as those areas where potential fast-water feeding areas with sufficient depth and escape cover occurred.

Discussion:

Environmental Conditions

Most of the base flow runoff in Guadalupe River is captured by Almaden, Guadalupe and Calero reservoirs. Water released from the reservoirs and from the Transvalley Pipeline maintains perennial stream habitat downstream to percolation ponds along Coleman Avenue and Almaden Expressway. The regulated flows are percolated in percolation ponds and in the streambed in the Blossom Hill area; little or no summer flow existed for much of the streambed downstream of Hillsdale Avenue until recent years. Los Gatos Creek, the major "tributary" to Guadalupe River historically carried runoff comparable to the Guadalupe River, as Los Gatos Creek drains moister portions of the Santa Cruz Mountains. However, the runoff in Los Gatos Creek is also regulated, especially by Lexington Reservoir, and its summer flows are all lost to percolation far upstream of its confluence with Guadalupe River. Summer streamflows throughout most of the lower Guadalupe River were very low or intermittent and were heavily influenced by storm drain runoff until recently.

Presently Canoas Creek contributes essentially all of the summer streamflow to lower Guadalupe River. Groundwater pumping associated with the cleanup of the IBM chemical spill contributes in excess of 10 CFS of water, making the Guadalupe River one of the best-watered streams in the urban Bay Area. This input of good quality water will cease, however, when the Water Quality Control Board allows IBM to terminate or alter its cleanup program.

The clay/silt banks of the incised channel of lower Guadalupe River do not contribute any gravels or other coarse substrate to the channel bottom. This, along with the long distance that coarse substrate must travel from the rockier headwaters through the low gradient valley floor, has resulted in a scarcity of gravels and larger natural rocks on the channel bottom. This scarcity, in general, becomes progressively worse downstream to the downtown area. Downstream of the confluence of Los Gatos Creek substrate improves, due to the historic addition of gravels and cobbles from the wetter, steeper Los Gatos Creek watershed. In the Guadalupe River much of the coarser substrate in the urban area consists of variously-sized chunks of concrete, especially near some of the bridges.

Because of the low gradient of most of the lower stream channel, the easily incised clay/silt banks, and the concentration of most of the elevation drop in a few steep riffles (especially at and downstream of bridges), 70 - 80% of the stream length occurs as pools and runs. The different surveyed segments do vary considerably in percentage of channel within the different habitat categories (Table F5), but in all segments pools are the dominant habitat (making up 38 - 76% of the stream sections). The stream sections with the highest percentage of pool and pool/run areas are West Virginia Avenue to Willow Street and Willow Street to Alma Street, where slow-water habitats make up 76 and 79 percent, respectively. The other four stream sections have 24 to 27 percent riffle/run and riffle habitat. Under the high flow conditions now occurring, most of the riffle/run and riffle habitat is deep enough to be utilized by fish; a return to previous flow conditions would result in much of the riffle habitat becoming dry or too shallow for fish use.

Downstream of the percolation ponds, present summer water temperatures are warm, probably exceeding 78 - 80 degrees (F) at many sites in summer. Upstream of Canoas Creek the warm water temperatures are due to low streamflows and a relatively unshaded channel. Downstream of Canoas Creek the high water temperatures are because the water from Canoas Creek travels nearly 5 miles in a shallow, unshaded channel before emptying into Guadalupe River. Water temperatures decline through the well-shaded channel downstream of Canoas Creek (Table F1) and probably seldom exceed 73 degrees at Highway 280. The degree of stream shading varies considerably within the six surveyed stream sections, but averages over 50 percent overall (Table F6). Highest shading is from Alma Avenue to Willow Glen Way and from Willow Glen Way to Malone Road, where section shade averages 66 and 71 percent, respectively. Even the least shaded section, West Virginia Avenue to Willow Street, averages 31 percent shade. From Highway 280, downstream, water temperatures increase due to the more open riparian canopy; at Highway 17 summer water temperatures often exceed 75 degrees. A return to low summer flows would probably result in summer water temperatures near 70 degrees at most sites, as long as the riparian canopy remains intact.

Turbidity in the lower Guadalupe River is presently high due to the high streamflows and the silt/clay banks and channel bottom. Turbidity increases downstream (Table F2), so that light penetrates only about a foot at Highway 280. Downstream of the Los Gatos Creek confluence water clarity improves, reflecting the improved substrate conditions. The more open canopy and increased cobble substrate for attachment result in increased algal growth downstream of the Los Gatos Creek confluence, and this may be an additional factor in the improved water clarity. The algae appears to trap much of the suspended sediment. Loss of flows in the Guadalupe River would result in improved water clarity, as at low streamflows most of the sediment will settle out.

Dissolved oxygen levels presently are high, because the abundant stream flow provides for mechanical aeration and for dilution of organic wastes and other oxygen-demanding substances. Return to the intermittent or low streamflows present before the IBM cleanup would result in poor aeration, oxygen depression due to undiluted storm drain inputs, and possibly wide oxygen level fluctuations associated with algal blooms at unshaded sites. Abundant trash at many of the urban sites represents a visual impact, but presently does not represent a problem for aquatic life, since the abundant flows can dilute oxygen-demanding substances and or small toxic inputs.

Fish Populations

Upstream of the percolation ponds, stream sections below Calero, Almaden, and Guadalupe reservoirs have good stream substrates and cool enough flows (Table F1) to support rainbow trout (Table F4). Riffle sculpin (Cottus gulosus), which also require cool, clean water and rocky substrate are present in Guadalupe Creek, upstream of Camden Avenue. More than seven miles of potential steelhead habitat are present above the percolation ponds, but are presently inaccessible, due to a 10 1/2 foot high drop structure at the percolation ponds upstream of Blossom Hill Road.

Downstream of the percolation ponds, fish populations are limited by available streamflow. In 1981 sustaining fish populations in the Guadalupe River, from Alma Avenue downstream to Hobson Street, consisted of goldfish (Carassius auratus) and California roach (Lavinia symmetricus). In the present survey 10 species and 1 hybrid were collected among the 18 sampled sites in the lower Guadalupe River, reflecting improved water quality and habitat conditions resulting from the increased flows (Table F3).

The first three sites downstream of the Alamitos percolation ponds were dominated by introduced species, especially juvenile largemouth bass (Micropterus salmoides), green sunfish (Lepomis cyanellus), and carp (Cyprinus carpio). California roach and juvenile Sacramento sucker (Catostomus occidentalis) numbers were suppressed in the presence of the abundant bass and green sunfish; roach were absent from suitable habitat at Branham Lane and both roach and suckers were restricted to shallow runs and riffles at Hillsdale Avenue.

Downstream of Canoas Creek native California roach, Sacramento suckers, and prickly sculpins (Cottus asper) dominated. Fish were most abundant in deeper riffles and runs where coarse substrate and attached algae provided food; roach and suckers are primarily herbivores, and the prickly sculpin is an insectivore.

California roach populations included a high proportion of older (3-4 years) and larger (to 6") individuals, reflecting the improved conditions due to stable streamflows, improved water quality, and access to food in riffles. At Hobson Street and at Highway 17 the closely related hitch were collected. They apparently invaded the Guadalupe River from Coyote Creek during the 1982 and 1983 high runoff years, when passage through the bay would have been possible. In the future they should spread upstream in the Guadalupe River and Los Gatos Creek.

Juvenile Sacramento suckers were present in the riffles of most of the sites. Adult suckers were most abundant where deep riffles, with abundant algae, were adjacent to deeper, slower run or pool habitat with abundant overhanging vegetation, undercut banks, or debris to serve as escape cover. They were not found in continuous shallow run and riffle habitat, such as might be found in flood-managed channels.

Prickly sculpins were found only in riffles, where coarser substrate and algal growth would provide conditions suitable for their insect food. Sculpins were common above Canoas Creek, but progressively declined downstream as riffle habitat and coarse substrate became scarcer; only a single individual was collected at Alma Avenue in 1986, and none were collected between Alma and the confluence of Los Gatos Creek in 1986 or 1987. Downstream of Los Gatos Creek sculpins were again common, reflecting improved stream substrate conditions, and possibly, migration from Los Gatos Creek.

No Pacific lamprey were collected in this study, but anadromous adults have been reported from the Guadalupe River and Los Gatos Creek.

King salmon were observed spawning in the Guadalupe River near Willow Glen Way in November of 1986, and other salmon were also observed, including near the mouth of Los Gatos Creek. Our 1987 stream surveys found 28 to 31 redds at 9 or 10 of the 13 potential spawning riffles present within the Canoas Creek to Highway 280 portion of the Guadalupe River (Figure F7). The Department of Fish and Game found possibly 36 redds within the same section of stream (Figure F8). Heaviest spawning in our survey was from Willow Glen Way to Malone Road and immediately downstream of Alma Avenue, where 28 of our 31 possible redds were located. The Department of Fish and Game found most of their redds downstream of Highway 280 (223 of 262), with the highest concentrations from Brokaw Road to Coleman Avenue (183 of 262). The Fish and Game survey also found 3 redds near Branham Lane, even though access upstream of Canoas Creek was very difficult in winter 1986-87. The high concentration of redds downstream of Los Gatos Creek in 1986-87 may reflect the generally better substrate conditions there, or may be an effect of poor winter streamflows and difficult access in 1986-87.

Although no juvenile salmon or steelhead were collected in either 1986 or 1987; marginal habitat does exist for them in the lower Guadalupe River. Adequate spawning gravels are present upstream of Canoas Creek, but summer stream temperatures are too warm for successful rearing, except far upstream, below the dams. Juvenile king salmon, however, can migrate out of the river in spring before water temperatures become a problem. Downstream of Canoas Creek spawning gravels are scattered and silted, but are probably adequate for small spawning populations of salmon or steelhead, especially downstream of Los Gatos Creek. Present high stream flows provide deep, fast-water riffles and runs for feeding, and potential steelhead and salmon rearing habitat makes up about one third of the river from Canoas Creek to Highway 280 (Table F9). However, high turbidities, high water temperatures, and generally low abundance of invertebrates probably allow summer rearing of only relatively low numbers of steelhead. The weir at Hillsdale Avenue and an abandoned stream crossing downstream of Branham Lane are presently the only potential barriers to steelhead or salmon upstream migration downstream of the percolation ponds. If the barriers were modified (or removed) and the drop structure at the percolation ponds were laddered, salmonid access to tributaries below the dams would be possible. Steelhead would probably naturally reestablish as strays from other South Bay Area steelhead streams, but could also be restored by stocking of appropriate (South Bay?) strains. Loss of present streamflows in the lower Guadalupe River would eliminate much of the potential steelhead feeding habitat, but the accompanying reduction in water temperatures might still allow a marginal population in the lower river. Loss of present streamflows would also make salmonid migration to and from habitat upstream of the percolation ponds (if a ladder were constructed) more difficult.

Table F1. Water temperatures (degrees F) for sites on Guadalupe River and tributaries in 1986 and 1987. Ranges are from maximum-minimum thermometers.

Site	Dates	Temperatures
Arroyo Calero at Harry Road	29 Oct 86 17 Dec 86	62 @ 12:35 54 @ 14:10
Alamitos Creek at Bridge 1 mile < Dam	29 Oct 86 17 Dec 86	62 @ 13:00 50 @ 14:50
Alamitos Creek at McKean Ave.	29 Oct 86	65 @ 12:45
Alamitos Creek near Via Valiente	29 Oct 86 17 Dec 86	64 @ 12:30 56 @ 12:45
Guadalupe Creek 1 mile > Pheasant Road	29 Oct 86 18 Nov 86	64 @ 13:30 57 @ 13:40
Below mouth of Pheasant Creek	29 Oct 86	61 @ 13:40
At SCVWD Gage on Hicks Road	18 Nov 86	56 @ 11:45 58 @ 13:02
Camden Ave.	29 Oct 86	61 @ 14:00
Meridian Ave.	29 Oct 86 18 Nov 86	64 @ 14:15 61 @ 10:30
>Blossom Hill at Drop Structure	17 Nov 86 25 June 87	59 @ 14:00 72 @ 09:25 74 @ 12:10
Branham Lane	5 Sep 86	77 @ 16:30
Hillsdale Ave.	26 July 86 26 July - 13 Aug 86 13 Aug 86 8 Sep 86 13 Aug - 8 Sep 86 11 Oct 86 8 Sep - 11 Oct 86	77 @ 18:00 70 - 80 77 @ 13:35 76 @ 16:40 68 - 80 68 @ 17:40 60 - 76
Canoas Creek at Snell Rd	13 Aug 86	76 @ 15:00

Table F1. (continued)

Canoas Creek at Almaden Exp.	26 July 86	73 @ 13:00
	13 Aug 86	74 @ 14:00
	26 July - 13 Aug 86	63 - 79
	8 Sep 86	74 @ 16:20
	13 Aug - 8 Sep 86	62 - 77
	11 Oct 86	69 @ 17:25
	25 June 87	75 @ 14:30
		77 @ 16:50
Curtner Ave.	26 July 86	65 @ 10:00
	13 Aug 86	73 @ 14:15
	26 July - 13 Aug 86	63 - 79
	8 Sep 86	73 @ 16:10
	13 Aug - 8 Sep 86	62 - 77
	11 Oct 86	69 @ 17:00
	8 Sep - 11 Oct 86	59 - 74
	26 June 87	64 @ 10:15
Old Almaden > Pine	5 Sep 86	68 @ 14:20
	8 Sep 86	70 @ 16:00
	5 Sep - 8 Sep 86	64 - 73
	11 Oct 86	64 @ 16:35
	8 Sep - 17 Nov 86	56 - 73
	17 Nov 86	60 @ 13:45
	21 Nov 86	63 @ 16:00
	17 June 87	68 @ 15:15
Willow Glen Way	26 June 87	66 @ 13:20
Alma Ave.	8 Sep 86	67 @ 15:45
	5 Sep - 8 Sep 86	65 - 73
	11 Oct 86	64 @ 16:05
	8 Sep - 29 Oct 86	58 - 73
	29 Oct 86	63 @ 11:15
	30 June 87	68 @ 10:10
W. Virginia Ave	18 July 86	65 @ 12:00
	13 Aug 86	70 @ 16:25
	30 June 87	70 @ 12:50
Auzerais Ave	5 Sep 86	69 @ 09:35
	8 Sep 86	68 @ 15:35
	5 Sep - 8 Sep 86	62 - 72
	11 Oct 86	66 @ 15:45
	8 Sep - 11 Oct 86	57 - 68
St. John St.	13 Aug 86	71 @ 16:25
	7 Aug - 13 Aug 86	67 - 74
	8 Sep 86	69 @ 15:15
	13 Aug - 8 Sep 86	66 - 72
	11 Oct 86	67 @ 15:25
	8 Sep - 11 Oct 86	60 - 69

Table F1. (continued)

St. John St.	30 June 87	73 @ 14:50
Coleman Ave.	5 Sep 86	70 @ 11:25
	8 Sep 86	70 @ 15:00
	5 Sep - 8 Sep 86	66 - 72
	11 Oct 86	67 @ 15:00
	8 Sep - 11 Oct 86	57 - 73
Highway 880	7 Aug 86	74 @ 16:30
	13 Aug 86	75 @ 16:50
	7 Aug - 13 Aug 86	67 - 77
	8 Sep 86	71 @ 14:45
	13 Aug - 8 Sep 86	65 - 76
	11 Oct 86	65 @ 14:40
	8 Sep - 11 Oct 86	61 - 72
Trimble Road	8 Sep 86	72 @ 14:30
	25 Aug - 8 Sep 86	64 - 78
	11 Oct 86	67 @ 14:25
	8 Sep - 11 Oct 86	59 - 74

Table F2. Turbidity (secchi depths) and dissolved oxygen at sites on Canoas Creek and Guadalupe River in 1986.

Site	Date	Secchi Depth	Dissolved Oxygen
Hillsdale Ave.	13 Aug	2+ meters	
	11 Oct	2+	10.5-11.9 mg/l @ 17:40
Canoas Creek @ Almaden Expressway	8 Sep	1.1	
	11 Oct	1.3	13.9 @ 17:25
Curtner Avenue	8 Sep	0.7	
	11 Oct	1.0	10.6 @ 17:00
Old Almaden > Pine	8 Sep	0.6	
	11 Oct	0.8	8.7 @ 16:35
Alma Avenue	8 Sep	0.35	
	11 Oct	0.07*	7.4 @ 16:05
W. Virginia Avenue	13 Aug	0.3	
	8 Sep	0.3	
Auzerais Avenue	8 Sep	0.4	
	11 Oct	0.3	8.6 @ 15:45
St. John Street	8 Sep	0.45	
	11 Oct	0.35	8.3 @ 15:25
Coleman Avenue	8 Sep	0.5	
	11 Oct	0.3	8.6 @ 15:00
Highway 17	8 Sep	0.6	
	11 Oct	0.1*	8.7 @ 14:40
Trimble Road	8 Sep	0.9	
	11 Oct	0.2*	9.9 @ 14:25

---

*Inchannel disturbance upstream of site.

Table F3. Fish collected in Guadalupe River in July - September 1986 and June 1987 (). Abundances rated on a scale of 1 - 5, where 1 is rare and 5 is very abundant (A = adult, J = juvenile).

Species	Sites				
	Blossom Hill Rd.	Branham Lane	Hillsdale Avenue	Mouth of Canoas Cr.	Curtner Avenue
Sacramento Sucker (*Catostomus occidentalis*)	(J2)	J1	J4	J4(J4) A4(A4)	J4(J3) A3(A2)
California Roach (*Lavinia symmetricus*)	(1)		3	4(5)	3(4)
Hitch (*Lavinia exilicauda*)					
Prickly Sculpin (*Cottus asper*)	(3)	3	4	2(2)	3(-)
Goldfish (*Carassius auratus*)					
Carp (*Cyprinus carpio*)		J4	J3	A2(A2)	
Mosquitofish (*Gambusia affinis*)				3	
Green Sunfish (*Lepomis cyanellus*)			3	2	
Largemouth Bass (*Micropterus salmoides*)	(J2)	J5	J3		
Pumpkinseed (*Lepomis microlophus*)	(A1)	J1			
Pumpkinseed X Green Sunfish		J1			

Table F3. (continued)

Species	Sites Old Almaden Road	Willow Glen Way	> Alma Avenue	< Alma Avenue	McClellan Avenue
Sacramento Sucker	A2(-) J3(-)	(J2) (A3)	J1 A1	J2(J4) A3(A2)	J3 A1
California Roach	3(3)	(4)	2	4(4)	3
Hitch					
Prickly Sculpin	1(1)		1		
Goldfish					
Carp					
Mosquitofish					
Green Sunfish					
Largemouth Bass					
Pumpkinseed					
Pumpkinseed X Green Sunfish					

Table F3. (continued)

Species	Sites W. Virginia Avenue	Auzerais Street	Santa Clara Street	St. John Street	Coleman Avenue
Sacramento Sucker	J4(J2) A4(A2)	J1 A1	J2	J4(J2) A3(A2)	J5 A2
California Roach	4(4)	3	2	4(4)	5
Hitch					
Prickly Sculpin				1	3
Goldfish			2	2	
Carp				(A1)	
Green Sunfish					
Largemouth Bass					
Pumpkinseed					
Pumpkinseed X Green Sunfish					

Table F3. (continued)

Species	Sites Hobson Street	 Highway 880	 Trimble Road
Sacramento Sucker	J4 A5	J2 A2	J1 A3
California Roach	4	3	2
Hitch	3	3	2
Prickly Sculpin	3		
Goldfish			
Carp			
Green Sunfish			
Largemouth Bass			
Pumpkinseed			
Pumpkinseed X Green Sunfish			

Table F4. Fish collected in the Guadalupe Creek drainage upstream of the percolation ponds in November - December 1986. Abundances rated as in Table F3.

Species	Sites Meridian Avenue	Guadalupe Creek Hicks Road SCVWD Gage	Hicks Road 1 mile < Dam
Rainbow Trout (*Salmo gairdneri*)		4	3
Sacramento Sucker (*Catostomus occidentalis*)	J2	3	3
California Roach (*Lavinia symmetricus*)	2	4	3
Brown Bullhead (*Ictalurus nebulosus*)			
Prickly Sculpin (*Cottus asper*)	1		
Riffle Sculpin (*Cottus gulosus*)		5	3

Table F4. (continued)

Species	Sites ------Alamitos Creek------ Near Via Valiente	 2nd Bridge < Dam New Almaden	 Arroyo Calero > Harry Road
Rainbow Trout	2	3	2
Sacramento Sucker	J4 A1	2	3
California Roach	4	2	3
Brown Bullhead		1	
Prickly Sculpin			
Riffle Sculpin			

Table F5. Estimated amount and percentage () of stream in various habitat categories for sections of the Guadalupe River in June 1987.

Stream Section	Pool	Pool/ Run	Run	Run/ Riffle	Riffle
	Habitat Category				
Hwy 280 to W. Virginia Ave.	800 ft	100	175	300	50
	(56%)	(7)	(12)	(21)	(4)
W. Virginia Ave.to Willow St.	1700	0	250	250	50
	(76)	(0)	(11)	(11)	(2)
Willow St. to Alma Ave.	1350	325	75	150	225
	(64)	(15)	(4)	(7)	(11)
Alma Ave. to Willow Glen Way	1475	225	75	275	350
	(61)	(9)	(3)	(11)	(16)
Willow Glen Way to Malone Rd.	1050	425	625	325	375
	(38)	(15)	(23)	(10)	(14)
Malone Rd. to Canoas Creek	1850	200	625	625	300
	(51)	(5)	(18)	(17)	(8)
Totals	8225	1275	1825	1925	1350
	(56)	(9)	(13)	(13)	(9)

Table F6. Proportions of habitat with various levels of shade in sections of the Guadalupe River. Cumulative percentage is in ().

Percent Shade	Hwy 280 - West Virginia	West Virginia - Willow St.	Willow St.- Alma Ave.
0			
5	18	46	19
10		2	7
15	14	2	
20	7 (39)	2 (52)	(26)
25	7		
30			
35		22	
40	(46)	(74)	47 (73)
45			
50	12	9	1
60			8
70			2
80	(58)	(83)	9 (93)
90	39	17	7
100	3		
Mean	50.3%	30.7%	40.7%

Table F6. (continued)

Percent Shade	Alma Ave. - Willow Glen Wy	Willow Glen Way - Malone Rd.	Malone Rd. - Canoas Creek
0			
5			1
10			
15			
20	14 (14)		12 (13)
25			
30		10	
35			28
40	(14)	3 (13)	24 (65)
45			
50	8	6	12
60		7	
70		26	10
80	66 (88)	31 (83)	13 (100)
90	12	18	
100			
Mean	65.6%	70.6%	46.4%

Table F7. Spawning habitat and utilization in the Guadalupe River in 1986-87, based upon consultant field survey.

Stream Section	Potential Spawning Sites	Utilized Sites	Spawning Depressions
Hwy 280 to W. Virginia Ave.	0	0	0
W. Virginia Ave. to Willow St.	2	1	2-3
Willow St. to Alma Ave.	4	3	12
Alma Ave. to Willow Glen Way	2	1-2	2-3
Willow Glen Way to Malone Road	5	4	12-13
Malone Road to Canoas Creek	0	0	0
Totals	13	9-10	28-31

Table 8 Spawning habitat utilization of the Guadalupe River by steelhead and salmon in winter, 1986-87, based upon Department of Fish and Game Stream Survey. Consultant totals in ().

Stream Section	Spawning Riffles	Spawning Patches	Spawning Depressions
Hwy 237 to Hwy 101	0	0	0
Hwy 101 to Brokaw Rd.	1	1	3
Brokaw Rd. to Hwy 880	9	26	64
Hwy 880 to Hedding St.	2	4	10
Hedding St. to Taylor St.	7	20	53
Taylor St. to Coleman Ave.	5	17	56
Coleman Ave. to St. John St.	2	-	25
St. John St. to San Carlos St.	1	-	11
San Carlos St. to Hwy 280	1	1	1
Hwy 280 to Alma St.	2 (4)	-	16 (14-15)
Alma St. to Willow Glen Way	1 (1-2)	-	3 (2-3)
Willow Glen Way to Malone Rd.	4 (4)	-	17 (12-13)
Malone Rd. to Canoas Creek	0 (0)	0 (0)	0 (0)
Canoas Creek to Blossom Hill Percolation Ponds	1?	-	3?
Totals	36		262

-39

-14

207

Table F9. Estimated amount and percentage of potential steelhead and salmon rearing habitat present in sections of the Guadalupe River in June 1987.

Stream Section	Section Length (ft)	Rearing Habitat Length (ft)	Rearing as % of Total
Hwy 280 to W. Virginia Ave.	1425	425	30
W. Virginia Ave. to Willow St.	2250	500	22
Willow St. to Alma Ave.	1825	575	32
Alma Ave. to Willow Glen Way	2400	600	25
Willow Glen Way to Malone Rd.	2800	1200	43
Malone Rd. to Canoas Creek	3600	1425	40
Total	14300	4725	33

Table 1. Spawning sites and utilization in Reach 3 of Coyote Creek in winter, 1986-87. US to Montague

	Downstream Half	Upstream Half
Potential Spawning Riffles	3	14
Riffles with Spawning Redds Present	0	6
Number of Redds	0	21

Salmonid Study of Guadalupe River, Coyote Creek and Selected Tributaries 1994-95 Report of Field Work

The Habitat Restoration Group

Habitat Restoration Group (HRG). 1995. Salmonid study of the Guadalupe River, Coyote Creek, and selected tributaries, 1994-95: Report of field work. Prepared for the Santa Clara Valley Water District, San Jose, CA.

Salmonid Study of Guadalupe River, Coyote Creek and Selected Tributaries

1994-95 Report of Field Work

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Salmonid Study of Guadalupe River, Coyote Creek and Selected Tributaries

1994-95 Report of Field Work

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1994-95 REPORT OF FIELD WORK

INTRODUCTION

Chinook salmon have been observed in Guadalupe River, and to a lesser extent Coyote Creek, during the past 10 years (The Habitat Restoration Group, 1987). Since chinook salmon were not historically documented in either Guadalupe River or Coyote Creek (Leidy 1984), the origin, life history and size of this population is currently unknown. While these salmon may be a remnant, undocumented population indigenous to the Guadalupe River, they could also be strays, or could have originated as strays, from salmon hatcheries in Sacramento-San Joaquin drainages. The endangered winter-run chinook (one of four races based on spawning season) occurred historically in the upper Sacramento River system and would not be expected to occur in the Guadalupe or Coyote drainages.

In response to intense public interest regarding these chinook salmon, the California Department of Fish and Game (CDFG) began collecting fin clips from adult chinook salmon for genetic analysis in November 1994. The genetic analysis may determine the origin of the Guadalupe River chinook. In addition, the Santa Clara Valley Water District (District) requested this study to gather additional information about chinook salmon and steelhead in Guadalupe River and Coyote Creek. This study is part of a five-year (1989-1995) evaluation of salmonid use and habitat conditions in the vicinity of spreader dams in Santa Clara Valley.

PURPOSE OF STUDY

This study was designed to investigate the presence and abundance of adult chinook salmon and steelhead, the location and abundance of redds, and reproductive success in the Guadalupe River, Coyote Creek, and several tributaries during winter and spring 1994-95. This study focused on chinook salmon in the Guadalupe River and two tributaries, Los Gatos and Ross creeks. Winter and spring stream temperatures were collected in the Guadalupe River to document temperatures that would be experienced by incubating eggs and salmonid young. In addition, this study provided the majority of fin clips CDFG will use for genetic analysis of the chinook salmon population.

AREA OF STUDY

The Guadalupe River and Coyote Creek drain into the lower portion of San Francisco Bay, in Santa Clara County. The study area included the Guadalupe River from Tasman Drive upstream to the drop structure upstream of Blossom Hill Road (Blossom Hill drop structure), and the lower portions of Los Gatos and Ross creeks. The study area also included portions of Coyote Creek between Old Oakland Road upstream to Metcalf Road and sections of Upper Penitencia Creek from its confluence with Coyote Creek upstream to the first bridge in Alum Rock Park.

METHODS

Adult Salmon and Redd Survey

River Survey. The Guadalupe River between Tasman Drive and the Blossom Hill drop structure was surveyed for adult salmon and salmon redds between 22 November and 1 December 1994. A team of two field biologists walked progressively upstream on 22, 23, 27, 29, and 30 November and 1 December 1994. The observations were not intended as a total count, but were used as an index of salmon abundance and spawning activity in reaches of the Guadalupe River.

The location of adults, redds and prominent riffle habitat was recorded in the study area. In the lower reaches, data were recorded on a street map and in a field notebook. In the upper reaches, data were recorded on aerial photo prints provided by the District and in a field notebook. Areas where redds were observed were resurveyed in April while sampling for young salmonids.

Los Gatos Creek (upstream to Hamilton Avenue) and Ross Creek (upstream to Leigh Avenue), two tributaries of Guadalupe River, were also surveyed for adult salmon and redds. Los Gatos Creek was surveyed 8 and 9 December; Ross Creek was surveyed on 9 December.

Population Estimate. The population of Guadalupe River chinook salmon was estimated based on two studies. The first was a mark and recapture of adults in the reach between Almaden Expressway and the Hillsdale weir. In this reach, adult salmon were captured, tagged, and released. On subsequent field visits, the reach was surveyed for salmon carcasses. The total number of carcasses and the number of carcasses that had been captured and tagged as live fish was recorded. The proportion of tagged to untagged carcasses was used to estimate the number of salmon which used the reach. Second, this estimate was expanded to the entire Guadalupe River based upon the proportion of the total adult fish observed in the river survey which were observed in the intensive study reach (between Almaden Expressway and the Hillsdale weir).

Guadalupe River Temperatures

Winter and spring stream temperatures were collected for three sites on the Guadalupe River: upstream of Blossom Hill Road, downstream of Foxworthy Avenue (upstream of streamgage 23B), and downstream of Trimble Avenue. Maximum/minimum (max/min) thermometers were located at all three sites, and checked periodically throughout the winter and spring. A HOBO thermometer, which takes temperature readings at specific intervals, was stationed near streamgage 23B (downstream of Foxworthy Avenue). Temperatures in the first HOBO set (23 November to 8 December) were recorded every 15 minutes. Temperatures in the second (9 December to 19 January), third (20 January to 5 March), fourth (9 to 23 May) and fifth (31 May to 18 June) sets were recorded every 36 minutes.

Sampling for Young Salmonids

Twenty-one sites including 10 on Guadalupe River, 7 on Coyote and 4 on Upper Penitencia creeks were sampled for juvenile salmon and steelhead in April and May 1995 with a backpack electroshocker (Figure 1). This sampling method limited sampling sites to habitats less than about three feet in depth. This limitation especially affected site selection in the lower Guadalupe River where deep pool habitat is common. Otherwise, fish sampling sites were selected to sample habitats that young salmonids would be expected to occupy. Most areas where redds were observed were sampled in Guadalupe River. In Coyote Creek, riffles that were identified as potential spawning sites (The Habitat Restoration Group 1995) were sampled upstream of Old Oakland Road. In Upper Penitencia Creek, areas where steelhead redds have been observed previously (HRG 1994), and potential spawning areas were sampled.

Due to extremely high streamflows and high stream turbidities in the spring of 1995, sampling for young salmonids had to be delayed until mid-April. Several sites on Guadalupe River were sampled twice; once in April to sample for chinook salmon juveniles and once in May to sample for steelhead young.

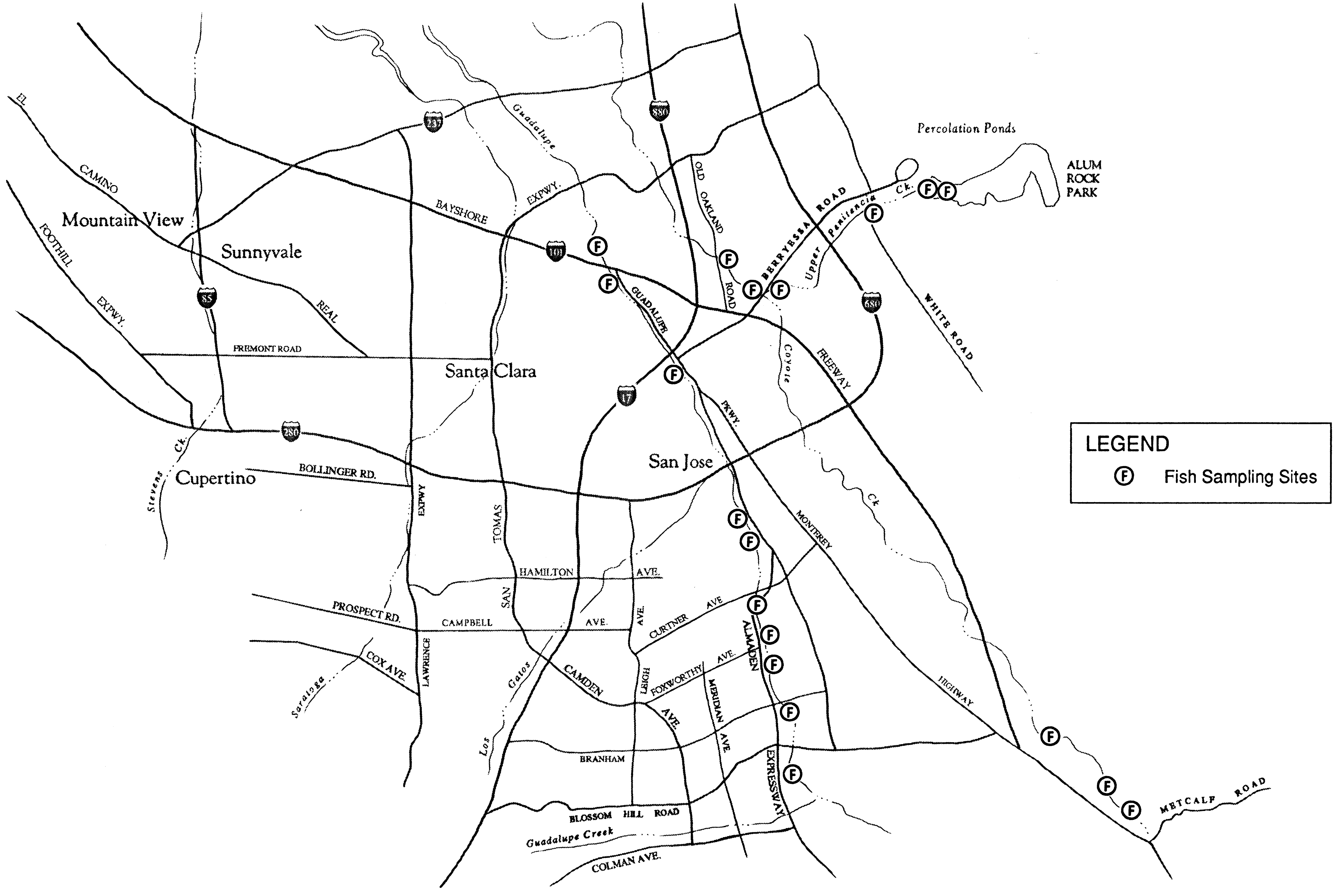
RESULTS

Adult Salmon and Redd Survey

Twenty-six chinook salmon redds were observed in the Guadalupe River study area (Table 1). The greatest number of redds were located in the lower two reaches of Guadalupe River (Tasman to Highway 101 and Highway 101 to Airport Blvd.) and in the two reaches between Almaden Expressway at Canoas Creek and Capital Expressway. All redds were observed in riffles or runs.

Twenty-nine live adult chinook salmon were observed in the Guadalupe River during the survey. The greatest number of adults observed in a reach was between Tasman and Highway 101 (8) and also between Almaden Expressway and the Hillsdale weir (7). No redds, live adults or carcasses were observed during surveys on Los Gatos and Ross creeks.

Two hundred and one (201) is the total estimated number of salmon in the Guadalupe River during the study (late November through early December). The number of salmon in 1994 was at least 64 (based upon live fish seen or tagged and untagged carcasses) with at least 42 fish concentrated between Almaden Expressway and the Hillsdale weir. The mark and recapture estimate for the Almaden Expressway to Hillsdale weir reach was 48.6 on 10 December (based upon 19 salmon previously tagged live and forty percent of the carcasses having been tagged fish). The estimate of 201 salmon for the entire Guadalupe River is based upon the mark and recapture estimate in the Almaden Expressway to Hillsdale Weir reach and upon sightings made while walking the entire stream which indicated that 24% of the salmon were probably concentrated in this reach in late November and early December (48.6 X 29/7 = 201). The



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1994-95 Spreader Dams Salmonid Study
Guadalupe River, Coyote Creek and Upper Penitencia Creek
Location of Fish Sampling Sites

FIGURE 1
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Table 1. 1994 Guadalupe River Chinook Salmon Survey

Reach	Number of Redds Observed	Number of Salmon Observed
Tasman to Highway 101	5	8
Highway 101 to Airport Boulevard	5	2
Airport Boulevard to Coleman	2	3
Coleman to Alma	0	1
Alma to Willow Glen Way	1	2
Willow Glen Way to Almaden Expressway at Canoas Creek	3	2
Almaden Expressway at Canoas Creek to Hillsdale Weir	4	7
Hillsdale Weir to Capital Expressway	4	3
Capitol Expressway to Branham Lane	0	1
Branham Lane to Drop Stucture at SCVWD	2	0
Total	**26**	**29**

number may have been substantially more, as some early run fish would not have been included in the estimate.

Data on sizes of 40 live salmon or carcasses from Almaden Expressway to Hillsdale weir is given in Table 2. Males made up most (83%) of the fish. Most males were smaller than females. Thirty-one of 33 males were less than 700 mm, with the smallest 480 mm. Six of 7 females were 700 mm or larger. All seven female carcasses had deposited their eggs. If the same sex ratio was applied to the estimated 201 spawning salmon in the Guadalupe River in 1994, there would have been 34 spawning females.

Guadalupe River Temperatures

Temperatures in Guadalupe River were collected from three sites (Blossom Hill Road, Foxworthy Avenue, Trimble Avenue) from late December to mid-June (Table 3).

A HOBO thermometer was set upstream of streamgage 23B (downstream of Foxworthy Avenue) five times between 23 November and 24 June. Battery failure in the HOBO thermometer resulted in the loss of all temperature data during the third set (20 January to 15 March). The HOBO was not retrievable during most of this period (20 January to 15 March) due to high streamflows. Battery replacement delayed the fourth set until 9 May.

Temperatures recorded between 23 November and 28 January ranged from 8.6 to 13.6°. HOBO temperatures recorded from 23 November to 8 December had a mean of 10.6°C. The minimum temperature recorded was 8.6° and the maximum temperature recorded was 12.2°. Most temperatures recorded were between 9 and 11°. HOBO temperatures recorded from 9 December to 19 January had a mean of 10.2°C. The minimum temperature recorded was 6.7° and the maximum temperature recorded was 13.4°. Most temperatures recorded were between 8 and 11°.

Maximum/minimum thermometers recorded temperatures 19 January to 11 February that ranged from 9.7 to 14.5° among the three sites. Minimum and maximum temperatures increased in mid-February, where temperatures ranged from 14.2 to 18.1° (11-21 February). Minimum and maximum temperatures from 25 March through 15 April ranged from 10.4 to 18.9, with minimum temperatures somewhat cooler 30 March to 15 April than 21 February to 30 March at the Foxworthy and Trimble sites.

HOBO temperatures recorded from 9 to 23 May had a mean of 17.3°C. The minimum temperature recorded was 14.0 and the maximum temperature recorded was 23.0°. Most temperatures recorded were between 14 and 19°. HOBO temperatures recorded 31 May to 18 June had a mean of 19.9°C. The minimum temperature recorded was 14.9 and the maximum temperature recorded was 23.7°. Most temperatures recorded were between 17 and 22°. Two extreme temperatures in the fifth set (31 May to 18 June) suggest that the HOBO thermometer was exposed to air; the last 25% of the data was not used in calculating the mean, minimum and maximum.

Table 2. Sample of Chinook Salmon Fork Lengths, Guadalupe River, 1994

Fork Lengths (mm)	Male (n=33)	Female (n=7)
475-499	MM	
500-524	MM	
525-549	MMM	
550-574	MMM	
575-599	MMMMM	
600-624	MMMMMM	
625-649	MMMMMM	
650-674	MMM	F
675-699	MM	
700-724		F
725-749		FF
750-774		FF
775-799	M	
800-824		F
825-849		
850-874		
875-899		
900-924		
925-949		
950-974		
975-999	M	

Table 3. 1994-95 HOBO and Minimum-Maximum Temperature Data from Three Sites on the Guadalupe River

Site	Blossom Hill Road	Foxworthy Avenue	Trimble Avenue	HOBO @ Foxworthy
Date				23 Nov - 8 Dec
Minimum (°C)				8.6
Maximum (°C)				12.2
Handheld (°C) @ Time				Mean = 10.6
Date				9 Dec - 19 Jan
Minimum (°C)				6.7
Maximum (°C)				13.4
Handheld (°C) @ Time				Mean = 10.16
Date		19 - 20 Jan		
Minimum (°C)		11.0	11.5	
Maximum (°C)		12.7	13.1	
Handheld (°C) @ Time		11.0 @ 14:00	11.5 @ 14:25	
Date	19 - 28 Jan	20 - 28 Jan		20 Jan - 15 Mar
Minimum (°C)		9.7	11.3	*Battery Failure - No Data*
Maximum (°C)	13.6	13.6	13.5	
Handheld (°C) @ Time	12.0 @ 14:40	12.5 @ 14:20	13.5 @ 13:55	
Date	28 Jan - 11 Feb		28 Jan - 4 Feb	
Minimum (°C)		9.7	12.9	
Maximum (°C)	13.7	13.6	14.5	
Handheld (°C) @ Time	12.0 @ 15:15	12.5 @ 14:50	14 @ 16:05	
Date	11 - 21 Feb			
Minimum (°C)	*Thermometer Exposed to Air*	14.2		
Maximum (°C)		18.1	18.0	
Handheld (°C) @ Time	17.0 @ 14:50	17.0 @ 15:20	17.5 @ 15:50	
Date	21 Feb - 10 Mar			
Minimum (°C)	*Water Level Too High To Check Thermometers*			
Maximum (°C)				
Handheld (°C) @ Time				

Table 3: 1995 Minimum-Maximum Temperature Data From Three Sites on the Guadalupe River (continued)

Site	Blossom Hill Road	Foxworthy Avenue	Trimble Avenue	HOBO @ Foxworthy
Date	10 - 25 Mar			
Minimum (°C)	*Thermometer Lost*	*Water Level Too High To Check Thermometers*		
Maximum (°C)				
Handheld (°C) @ Time				
Date	25 - 30 Mar	21 Feb - 30 Mar		
Minimum (°C)	14.3	14.3	16.4	
Maximum (°C)	16.6	17.1	17.5	
Handheld (°C) @ Time	16.0 @ 9:30	16.5 @ 10:05	17.5 @ 10:35	
Date	30 Mar - 15 Apr			
Minimum (°C)	10.5	10.4	14.7	
Maximum (°C)	17.1	17.6	18.9	
Handheld (°C) @ Time	16.0 @ 14:20	16.5 @ 14:50	17.5 @ 15:30	
Date	15 - 27 Apr			
Minimum (°C)	*Thermometer Lost*			
Maximum (°C)				
Handheld (°C) @ Time	16.5 @ 11:40	15.5 @ 12:15		
Date		9 May		
Minimum (°C)		*Thermometer Lost*		
Maximum (°C)				
Handheld (°C) @ Time		15.5 @ 12:15		
Date		9 - 23 May		9 - 23 May
Minimum (°C)		12.6		14.0
Maximum (°C)		22.6		23.0
Handheld (°C) @ Time		16.0 @ 10:35		Mean = 17.25
Date		23 May - 18 June		31 May - 13 June
Minimum (°C)		13.7		14.9
Maximum (°C)		23.7		23.7
Handheld (°C) @ Time		none		Mean = 19.89

Sampling for Young Salmonids

No juvenile chinook salmon were captured during April and May sampling in Guadalupe River, Coyote Creek or Upper Penitencia Creek.

Three juvenile rainbow trout/steelhead were captured in Guadalupe River during spring sampling (Table 4). One juvenile was captured downstream of Alma Avenue and two were captured downstream of the Blossom Hill drop structure. Rainbow trout captured in Upper Penitencia creek were larger than would be expected for a one or two year old steelhead, and were probably resident rainbow trout.

In addition to rainbow trout/steelhead, six native and eight non-native fish species were captured during spring sampling on Guadalupe River, and Coyote and Upper Penitencia creeks.

All fourteen native and non-native fish species were captured among the ten Guadalupe River sites. The native prickly sculpin and the non-native green sunfish were the most widespread and were each found at seven sites. However, prickly sculpin were not captured at sites downstream of Willow Glen Way. The anadromous Pacific Lamprey was captured at two sites, and possible Lamprey redds were observed during the redd survey. Riffle sculpin, not generally observed in the Guadalupe River (HRG 1995), were captured at the two most upstream sites (Blossom Hill and Branham Lane). Non-native centrarchids, especially green sunfish, pumpkinseed and bluegill, were the most abundant and widespread of the non-native fishes. These non-native centrarchids were somewhat more abundant at the more upstream sites. Non-native goldfish, mosquitofish, and inland silverside were each captured at one site.

Seven fish species (goldfish, California roach, hitch, Sacramento sucker, prickly sculpin, bluegill, largemouth bass) were captured at the six Coyote Creek sites. In general, fish abundances were low, but fish were most abundant at the most upstream site, downstream of the steel dam. This site, immediately downstream of Metcalf Pond, featured a large pool with low velocities and abundant overhead cover. One native (Sacramento sucker) and three non-native fish (goldfish, bluegill, largemouth bass) were found only at this site. Hitch and prickly sculpin were captured only at the most three upstream sites (downstream of steel dam, Silicon Valley Boulevard, Ford Road Dam #6), whereas California roach were captured only at the two most downstream sites (upstream of Old Oakland Road B and C).

In addition to rainbow trout, two species of native fish (California roach and riffle sculpin) were captured at each of the four sites sampled on Upper Penitencia Creek. The abundance of California roach increased downstream from uncommon (6 to 14 individuals) to abundant (30 or more individuals). Riffle sculpin were uncommon (6 to 14 individuals) or common (15 to 29 individuals) at the four sites.

Table 4. Location and abundance of fish species captured. Fish species collected by electrofishing at 21 stream sites.

	Guadalupe River														Coyote Creek							Upper Penitencia Creek			
	Upstream of Blossom Hill Road		Upstream of Branham Lane	Upstream of Capitol Expressway		Downstream of Weir 23B		Downstream of Willow Glen Way	Upstream of Curtner Avenue	Downstream of Alma Avenue		Downstream of Taylor Street	Downstream of Airport Blvd.	Downstream of Trimble Road	Downstream of Coyote Steel Dam	Silicon Valley Blvd.	Downstream of Ford Rd. Dam site #6	Upstream of Berryessa	Upstream of Old Oakland Road, site A	Upstream of Old Oakland Road, site B	Upstream of Old Oakland Road, site C	Alum Rock Park, downstream of 1st bridge	Alum Rock Park, upstream of gate	Upstream of White Road	Downstream of White Road
1995 date sampled (month/day)	4/14	5/26	4/17	4/25	4/26	4/14	5/26	4/20	4/25	4/25	5/26	4/20	4/17	4/17	5/16	5/16	5/16	5/18	5/18	5/18	5/18	5/16	5/18	5/18	5/16
Length of habitat sampled (ft.)	100	145	25	280	170	200	163	50	170	85	48	50	150	220	85	38	164	88	80	92	15	97	169	147	140
Pacific lamprey *					·	·																			
Goldfish					∙										∙										
Carp	·			∙					·																
California roach *		∙						•	∙				•	∙					·	·	·	•	•	●	⬤
Hitch *													∙	∙	•	·	·								
Sacramento sucker *			∙		∙										•										
Rainbow trout (resident) *																						·	·		
Rainbow trout (steelhead) *		∙								·															
Mosquitofish					·																				
Inland silverside		∙																							
Prickly sculpin *	∙	⬤	·	·	∙	·	∙								⬤	•	•								
Riffle sculpin *	·	·																				•	●	•	•
Green sunfish		•		•	●		·	·	∙					∙											
Pumpkinseed		•		·	●	∙								•											
Bluegill		•					·								∙										
Largemouth bass									·					·	∙										

Legend

⬤ Abundant (30 or more individuals)
● Common (15 - 29 individuals)
• Uncommon (6 - 14 individuals)
∙ Few (2 - 5 individuals)
· Rare (1 individual)
☐ No fish captured
* Native fish

DISCUSSION

Fish Habitat Requirements

Success of anadromous fish spawning and rearing depends on several habitat factors, including cool temperatures, high dissolved oxygen levels and substrates for spawning and rearing. Salmonids of all life stages prefer cool temperatures, below 18.3°C (65°F), and well oxygenated water. As water temperatures increase, salmonid survival is dependant upon high food productivity and high dissolved oxygen levels. The incubation period for chinook and steelhead eggs also varies with stream temperatures.

The presence and abundance of spawning gravels, in-stream cover for juvenile salmonids, and habitat for aquatic insects are determined by substrate composition. Clean gravels, 1/16 to 4 inches in diameter, are the primary substrate salmonids use for spawning. Spawning gravels are usually located in riffles, runs, and pool tail crests where moving water oxygenates the eggs in the redds.

Adult Salmon and Redd Survey

While the survey was conducted in as few days as possible to reduce the chance of counting an individual in two different sections of the river as it moved upstream, the survey was delayed following a storm event that resulted in high turbidity and restricted visibility for adults and redds. While this delay increased the chance of counting an individual twice, the chance was small as only a portion of salmon present in the river were seen. The survey was also restricted to prime daylight hours to insure good visibility. The observations give a general idea of relative salmon use of Guadalupe River reaches. However, the survey was conducted in November and December after some fish had probably already spawned and died.

Results indicate that a major portion of the salmon run in 1994-95 was concentrated immediately downstream of streamgage 23B and the Hillsdale weir. These two structures blocked migration except at high storm flows. The results also indicate that many of the salmon spawn downstream of Airport Boulevard, even when passage upstream to the Blossom Hill drop structure was possible.

Guadalupe River Incubation Conditions

Chinook Salmon. Temperatures recorded during chinook incubation period for late spawning (November) fish were suitable for egg survival. At 16°C, chinook salmon eggs experience a 50% mortality and require an incubation period of 32 days (Alderdise and Velsen 1978). For maximum egg survival, stream temperatures should be less than 14°C (Moyle 1976). Cooler temperatures may increase the egg incubation period; observed temperatures suggest an incubation period of 40 to 45 days. Based on an incubation period of 40 days, eggs observed in redds between 22 November and 1 December would have hatched by mid-January. All HOBO and max/min temperatures recorded during this period were cooler than 14°, and probably averaged around 10°C at Foxworthy. Based upon max/min results, Trimble Road redds probably experienced water temperatures 1 to 2 degrees higher, but also should have had suitable rearing temperatures.

Temperatures recorded during the period that chinook fry remain in the gravel were suitable for survival. Based on an incubation period of approximately 40 days, with an additional 3 to 4 weeks in the gravel (Alderdise and Velsen 1978), fry would emerge in mid-January to mid-February. Maximum temperatures were still low through at least 11 February (12.7 to 14.5° at the three sites). Temperatures increased in mid-February (11-21 February to 18.1°C) occurred after most salmon should have emerged from the gravels.

Chinook salmon populations exhibit a variety of life history strategies, but most California chinook begin to migrate downstream within two months of emergence (Moyle 1976). Based on redd observations, chinook juveniles may migrate downstream from mid-February to early April. The increased temperatures collected in late February and March would not likely affect egg incubation and fry survival.

While temperatures in late November 1994 through early February 1995 appeared suitable for egg and fry survival in Guadalupe River, other factors could have influenced the survival of eggs and young salmon. Since eggs incubate in gravel, they rely on oxygen that is available in the interstitial spaces in the substrate. Consequently, the quality of spawning gravels, including substrate size and the amount of sedimentation can strongly influence egg and fry (prior to emergence from the gravel) survival. Sedimentation clogs the interstitial spaces and greatly reduces the amount of oxygen available in the substrate. In addition, sedimentation contributes to high turbidity, which reduces visibility required by visual feeders such as salmon fry. Gravels used by spawning salmon in Guadalupe River were generally shallow and contained a high percentage of sand and silt, potentially impairing hatching success.

Storms in January and February probably scoured and destroyed most eggs and fry still in the gravels. Even fry which had already emerged would probably have suffered heavy mortality due to the storm flows.

While the winter storms of 1994-95 were atypical, other environmental factors, such as substrate composition, incubation temperatures for early spawners, and winter and spring temperatures in other years, may limit the sustainability of a chinook salmon population in south bay streams.

Steelhead. For all life stages, optimal steelhead survival occurs at stream temperatures of 13 to 21° (Moyle 1976), with egg incubation representing the most sensitive life stage. Steelhead eggs hatch in 3 to 4 weeks at 10 to 15° (Moyle 1976). Like chinook, steelhead fry spend an additional 2 to 3 weeks in the gravel.

Since few adult steelhead were observed in Guadalupe River and no steelhead redds were observed during spring sampling, the incubation period in the Guadalupe River is unclear. Adult steelhead were observed at the Blossom Hill drop structure in February (J. Smith, pers. comm).

Max/min temperature data during late February and March indicate suitable incubation temperatures. Maximum temperatures at Blossom Hill, Foxworthy and Trimble were 17° or less late February through March. In addition, most temperatures late March to mid-April were suitable for steelhead incubation. However, early March storms could have scoured and destroyed most eggs and fry still in the gravels. Even fry which had already emerged would probably have suffered heavy mortality due to the storm flows. If steelhead spawned after the March storm, their redds would not have been lost to scour.

While the winter storms of 1994-95 were atypical, other environmental factors, such as substrate composition, spring and summer rearing temperatures, and passage conditions may limit the sustainability of a steelhead population in south bay streams. Summer rearing temperatures may be one factor limiting the steelhead population in Guadalupe River, where typical summer temperatures are conditional (18.3 to 24.4°) or restricted (> 24.4°) for steelhead rearing, and rearing suitability depends on food availability (HRG 1995).

The three juvenile rainbow trout/steelhead captured by electrofishing in April and May in the Guadalupe River may represent steelhead. They could also represent juvenile rainbow trout washed downstream from Alamitos and Guadalupe creeks with the high flows of March and April. Even sedentary riffle sculpin were apparently washed downstream during 1994-95 winter storms.

SUMMARY

This study was unable to determine if chinook salmon occurring in the Guadalupe River represent a self-substainable and reproducing population. An estimated 201 chinook salmon, including 34 females, migrated into the Guadalupe River in 1994. Chinook salmon migrated into the Guadalupe River and spawned in the fall and winter of 1994-95, but no chinook juveniles were captured during spring sampling. However, juveniles may have migrated out of the Guadalupe prior to sampling, which was delayed due to high flows and turbidity, or were missed in the limited sampling effort. Stream temperatures during egg incubation and early fry development appear to have been suitable for survival. Although November to January incubation temperatures were suitable, fry and eggs were probably destroyed during scour associated with extreme streamflows and flooding in the winter 1995.

To better evaluate the chinook salmon run in the Guadalupe River, the District plans to conduct additional research in fall and winter 1995-96, including more extensive temperature monitoring and up- and down-migrant trapping. Results of the genetic analysis may further elucidate the origin and status of this chinook salmon population.

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